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FISHERY INVESTMENT PROJECTS:
Their Identification and Preparation

A Manual

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MANUAL ON THE IDENTIFICATION AND PREPARATION OF FISHERY INVESTMENT PROJECTS

by

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 1976

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PREPARATION OF THIS MANUAL

This manual has been prepared by a consultant employed by the FAO Fishery Industries Division under the Organization's Regular Programme of Work. The objective of the manual is to provide guidance to government and industry staff in identifying, formulating, and evaluating fishery investment projects.

Use of the manual will stimulate the preparation of soundly conceived proposals which may, in turn, lead to an increased and quicker flow of investment resources into developing countries from financing institutions and commercial investors.

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CHAPTER I - Introduction

1.1 Purpose of the Manual

The process of economic development is, in developing countries, largely one of progression from the general to the particular. First comes the formulation and definition of national economic and social priorities in qualitative terms, then, more specifically, their embodiment, more or less quantified, in national development strategies and plans. Sectoral plans come next, and finally specific investment projects for their implementation. One can conceive this process in reverse, as perhaps in Europe in the nineteenth century, where specific new investment activities, justified purely in terms of probable costs and returns dictated the course of economic development and subsequent national policies, but today, in pursuit of accelerated development, Governments, and their planning function, tend to take the lead.

It is to be noted that however well or purposefully this process is carried out, no development takes place until the projects have been carried through to successful operation. All that goes before is preparatory to the pouring of concrete, training of work forces, welding of ships, etc. In a significant phrase, it has been said that projects are "the cutting edge of development"1/. A sound and effective development plan, therefore, depends entirely upon a set of investment projects, both individually effective in terms of their own viability and collectively in their contribution to national objectives.

By virtue of both its Regular Programme activities and, especially its involvement in a wide variety of field activities in all parts of the world, FAO has a particular responsibility for assistance to Governments in the field of project identification and analysis. The United Nations Development Programme, primarily concerned with pre-investment activities, has, in recent years, placed much more stress upon investment-oriented programmes, and the identification of investment opportunities. Similarly, the international development banks and bilateral financing agencies now require, as a result of past experiences, better and more comprehensive preparation of loan and aid applications. Within the fields of agriculture and fisheries, much of this increased emphasis falls to be discharged by FAO, and its field personnel. FAO has already published studies in the field of investment analysis, with primary emphasis on Agricultural projects (see Bibliography). With respect to fisheries, although a number of publications have dealt with specific aspects of fisheries investment, the need has been felt for a review of investment appraisal techniques and problems, as they apply to the fisheries sector, and the issue of a set of guidelines for the identification and preparation of fisheries projects.

The object of the present work therefore is to assist those concerned with the practical aspects of fishery project identification and preparation to choose appropriate methods and to achieve some degree of consistency and standardization. It is principally intended for the guidance of:

(a) fishery administrators responsible for fishery investment planning,

(b) government officials in central planning bodies,

(c) staff of national development banks,

(d) participants in FAO-sponsored training courses

(e) FAO field project personnel

It will be clear that there is more than ample room for methodological disagreement between specialists in the field of investment appraisal. Whilst appropriate reference is made to the principal issues in the test this is intended to be a work for the non-specialist, and seeks only to review the principal, received methods of project formulation and appraisal in relation to the special features of fishery industry investment, with the object of assisting in better project preparation.

There is nothing difficult or esoteric about the methods and mathematics involved. Most of the problems in practice arise from the difficulties of estimating important parameters on the basis of inadequate information.

Finally, project evaluation ends with a number, say the Internal Rate of Return, or Present Value, which has no independent value scale of its own. In some circumstances an IRR of 10 percent is acceptable, whereas in others, an IRR of 30 percent would not produce institutional or private

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1/ J. Price Gittinger - "Economic Analysis of Agricultural Projects.Ch.I.

financing. This is to say that the purpose of project appraisal is less to establish a uniquely probable rate of return on the capital involved than to reveal the financial and economic "bones" of a project, and to establish its ranking among other competing possible projects in the economy at large, similarly measured. In the final analysis, the appraisal specialist cannot assume the role of the investor. Even where none of the figures and computations is disputed, final acceptance or rejection of a project depends, in the large part, upon the "feel" of the investor or financing institution for the degree of risk involved, their evaluation of non-quantifiable social effects, political factors, etc.

What is hoped for in this work is that future fisheries projects will be well prepared, internally consistent, and evaluated according to established, international bank-approved techniques.

1.2 Projects and Project Appraisal

It will be apparent that no investor would undertake an investment project without some assurance that the returns will be worthwhile, and to this extent, some form of project appraisal and evaluation is inevitable for decision-making. However, in relation to developing countries faced with a shortage of almost all kinds of resources, it has a special importance. The maximum rate of economic development depends upon the selection of the most efficient set of projects out of all possible alternatives, efficient, that is, in the sense of maximum contribution to economic growth and social goals. To choose a project of lesser efficiency, even one in itself quite viable, clearly represents a loss of welfare or growth as compared with the foregone benefits of the better project. Good project appraisal is therefore vital in the development process.

A 'project' needs to be defined. In the literature of project appraisal there are numerous definitions of what constitutes a project. Given the wide variety of possible activities and objectives and the special characteristics of many sub-sectors, such as fisheries or agriculture, a single water-tight definition is not possible.

Generally, however, a project is a single, well defined activity, requiring the investment of resources in a technically coherent process with the object of producing, over time, an output.

The output may often not be in the form of goods and services capable of precise valuation, say, teachers, research results, literacy or medical care, and we are not in this Manual concerned with the special problems of justifying such projects. Our concern is with projects which have outputs, both direct and indirect, which can be quantified in money terms, be they physical goods and services, quality improvements, savings in losses from spoilage, or infrastructure which raises the efficiency of existing activities.

We are concerned only with investment projects in the fisheries sector, which embraces the catching of fish, its processing, and marketing in a variety of forms, and the provision of necessary infrastructural services. We are not especially concerned here with projects involving capital expenditure, for the production of, say, fishery scientists or administrators, research results, institutions of one kind or another, all of which are highly necessary but which pose problems of valuation. We may, marginally, however, include projects for the training and development of the manpower required, where these are part of a larger productive project.

We go on to discuss some special features of projects in the fisheries sector in more detail, and will define a fisheries investment project, following the definition of fishery activities used by the Inter-American Development Bank as:

> a coherent and integrated set of activities, requiring physical investment for the catching or extraction, handling, processing, preservation and marketing to the final consumer of animal and plant life whose normal habitat is water. In this, we may include the provision of a suitable habitat, as in aquaculture projects, and the provision of necessary infrastructure, such as ports and landing places for the forementioned purposes.

1.3 Special Characteristics of Fisheries Industries

Such projects exhibit certain special characteristics of which note must be taken in their preparation. Of course, all projects are unique, and other sectors of the economy, industry or agriculture, exhibit their special characteristics. The particular aspects of fisheries projects requiring special consideration arise mainly from the fact that the activity is based upon a renewable natural biological resource whose abundance and productivity is affected by the fishing effort. Whilst many fisheries take place within national waters, most of the principal fisheries occur outside national jurisdiction, the

resources are the common heritage of mankind and there are special problems of management and international economic relations. It inhabits an environment largely hostile to man, and where weather conditions often have an important influence upon results. Its bases of operation are necessarily mainly on the coasts, frequently in areas of low economic development, and often requiring substantial infrastructural investment for even a modest scale of operation.

Once removed from its natural environment, fish spoils very quickly, necessitating rapid and effective marketing structures and/or sophisticated and expensive methods of preservation. Some special problems are posed by the fact that due to weather or fish behaviour, many fisheries are markedly seasonal in nature, giving rise to price instability and gluts, or to underutilization of fishing and processing capacity. Many existing fisheries throughout the world are prosecuted by small-scale, artisanal fishermen whose development problems are as often social and institutional in nature as purely economic.

Above all, and as a result of the foregoing factors, fisheries projects are generally marked by a relatively high degree of risk and initial uncertainty, which makes it very important that careful and objective project appraisal is made.

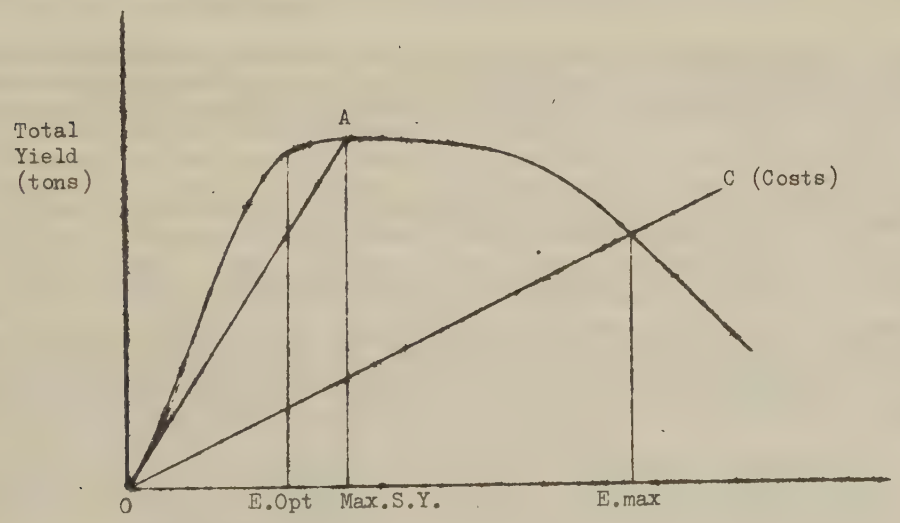
In the following sub-sections specific consideration is given to certain aspects of these special features of fisheries projects before we consider the processes of project formulation and appraisal.

1.3.1 The biological basis

It is not proposed in this section to discuss, other than superficially, the theories of fish population dynamics, but to consider the generally received aspects of the theory of particular relevance to the design of fisheries investment projects.

A stock of fish of a particular species is considered capable of yielding up part, or conceptually, even all of its total weight by the application of fishing effort. In the short run, i.e., instantaneously, changes in catches follow fairly proportionately upon changes in fishing effort. However, removal of young and breeding fish, changing the population size and balance (age composition), affects the future size and composition of the stock and hence the future relationship between catches and fishing effort. Over time therefore there is a relationship between present fishing effort and future stock size and catch per unit fishing effort. This relationship may be displayed in a diagram such as Figure I.

FIGURE I



The Long-run Yield/Effort Curve

In general the total yield, as fishing effort increases, rises to a maximum followed by a fairly flat portion, and then by subsequent decline. We should be clear that such a total yield curve is a construct to illustrate one particularly long-run characteristic of the fishery, and due to many other factors than pure population theory, actual catches in any future year may differ markedly from those predicted by the Total Yield Curve. Principal among these are the stochastic nature of the spawning and survival of young fish, and changes in environmental conditions. Ideally, the curve should be continuously updated to take account of the fluctuations in recruitment etc., which largely would imply the raising or lowering of the curve on the vertical axis, whilst preserving its shape. The curve therefore is both long-term, i.e., after allowing fishing-induced changes to work through the stock composition, and probabilistic in nature. It will be apparent that as a guide, or determinant of fisheries policy or investment, its estimates of maximum or sustainable yield, or of catch per unit fishing effort, will be subject to a relatively high degree of uncertainty.

Considering the curve (Figure I) from the fishery management point of view, we may distinguish the point of Maximum Sustainable Yield. The yield per unit fishing effort, which may be translated as catch per unit vessel/day, is given by the slope of the line OA from the origin, and in all cases this declines with increasing effort. In the relatively flat portion of the curve, whilst total yield remains fairly constant, catch per day falls, and costs (per total effort) OC rise, to a point (OEmax) where they are equal, and the fishery ceases to be profitable. The significance of this is that, although at some point, actual total catch declines sharply with increasing effort, the principal economic loss is the employment of fishing effort, at substantial costs in excess of that required to take the maximum total yield. For a unique set of costs (OC) we may distinguish Effort (Eopt) where the difference between costs and yields is at its maximum, giving the maximum economic benefit from the fishery. This point is given where the slope of the Yield curve is equal to the slope of the Cost curve.

Except in the rare cases where an investment project is designed to exploit the full potential of a managed fishery, these considerations are not directly relevant to the dimensioning of a fisheries project. Where, for instance, more than one country is fishing the fish stock, no unique set of cost curves exists, and no unique economic optimal level of effort. Similarly, unless a fishery can be managed on a private or governmental basis, with control of the fishing effort, Maximum Sustainable Yield is not an operational concept for determining the scale of an investment project. That the fishing effort should not be allowed to increase to the point where total yield actually falls, implying damage to the natural resource, is a self-evident ethical proposition, and, further, an investment project predicated on this would necessarily be short-term and dubious.

Where a fishery is currently exploited by others, particularly by other nations, a satisfactory investment project can still be framed, in the full knowledge that the incremental effort proposed will if not diminish total yields, at best result in no increase as long as the incremental share to the additional effort is worth more than the associated costs. Of course, in this situation, uncertainty is increased by lack of knowledge of the response of the existing operators.

The significance of the Maximum Sustainable Yield to the investment analyst, as opposed to the specialist in fisheries resource management, or fisheries planner, is that it may give assurance or grounds for caution as to the continuance of predicated catches per unit effort over a sufficient time span to render the project viable. What matters to the project is catch per unit effort, and its stability.

It goes without saying that for any large or long-term project, the designers should seek biological advice, and the best estimates of Maximum Sustainable Yield.

Of more specific and concrete importance however are good estimates of catch per unit effort, both present and future. For existing fisheries this may present no undue problem, but for a new fishery great care is required. It should be remembered that population dynamics calculations depend much more upon data generated from commercial fishing operations than from specialized research cruises. Statistically valid data on ages and year-class composition require a substantial sampling of catches, normally obtained from commercial landings. Where these are not available, uncertainty about present and future yields may be rather high. Even where good data are available, it is very difficult to make good estimates of future yields in a new fishery, until the commercial fishing effort has had some effect upon the stocks. All proposed projects need good and realistic estimates of yields, and these must be obtained, if not otherwise available, by special pre-project commercial fishing trials. The interpretation of such limited results is a specialized task for the biologist.

Where a substantial fishery is already in existence, and it is believed that the Maximum Sustainable Yield has already been reached, consideration must be given to the future effect of the

proposed project upon Catch per Unit Effort. At its simplest, this means dividing the existing total yield by the future total effort. The speed of the change will depend in large part upon the age structure of the fish population, and the ages at recruitment to the fished stock and at sexual maturity. Wherever possible, the time profile of changes in Catch Per Unit Effort should be calculated, and used in projections of future vessel earnings, etc.

Apart from questions of the size of total yield, and Catch per Unit Effort, most projects will be vitally influenced by other biological and physical aspects of the fish population. Principal amongst these may be mentioned:

1. Year-to-year changes in fish availability - Some fisheries are highly dependable from year to year, whereas some others suffer from apparently random variations in fish availability, for reasons largely unconnected with the fishing effort deployed. They may be affected by oceanographical or hydrographical factors, as for instance the effect of the "niño" current in the Peruvian anchoveta fishery, or the migration patterns of Atlantic tuna. Some coastal fisheries are affected by freshwater run-off from the land, or a late spring. For any project, the annual consistency of catches and catch rates needs to be assessed, and the results employed in the evaluation of the risk and uncertainty of the project.

2. Seasonality in fish availability to migration or spawning behaviour - Due to numerous constraints in the catching and marketing processes, marked seasonality will always result in higher costs, lower landings and underutilization of plant, as compared with an even flow. Forecasts based on simple annual averages are likely to be misleading, and landings and costs should be estimated on a weighted monthly basis when determining the main parameters of the project design.

3. Seasonal changes in the fish catches, such as oil content, fish condition, size, etc., which have a great importance for certain types of processing industry.

4. Weather conditions, which may affect catch rates.

5. Variations in the species composition of catches.

For a new fishery, lacking detailed historical record, it will often be difficult to assess these factors with precision. Use may be made of surveys, especially accoustical surveys and trial fishing operations to help define the characteristics of the resource, but it is certain that for any new fishery, there will initially be a large degree of uncertainty. In these circumstances, it will normally be prudent to design a project, where possible, in phases so that initial assumptions about the resource and the vessel operations may be tested through a sufficient period of, say, one year. Similarly the project, or the sponsors, should institute systematic collection of relevant biological and catch data for future decision-making.

Techniques for coping with these inevitable uncertainties are discussed later, but it is noted here that the art, as opposed to the techniques, of project formulation is the evaluation of the 'quality' of the data and the estimates available, and to know how much reliance can be placed on them.

For a project envisaging the expansion of an existing fishery, or of a new marketing or processing sector, good estimates will often be no problem, but in other cases, the range of uncertainty will be great. The best advice to give is that biological advice should be sought at the beginning of project formulation, utilizing all sources of information. The marshalling of available data and its interpretation is a specialist task. Where much uncertainty remains, projects should, where technically possible, start small and build upon acquired data or be preceded by a pilot or pre-feasibility project.

It will be, perhaps, but rarely that a single project will have the objective of maximizing the return from a single fishery, though one can envisage such a case in closed systems such as lakes, or for largely sedentary fish populations such as, for instance, crabs or lobsters. Such a comprehensive approach is more commonly to be found in planning and policy studies rather than in investment projects.

We should, however, clear up at this point the objective of fishery management, as it affects projects. We neglect, in this work, the possible and small difference between "economic" optima (i.e., the margin between Costs and Revenues) and Maximum Sustainable Yield as objectives of management, and consider the point that, as described in a later section on the use of discounting rates, the present value of relatively longer term benefits is very low. It must be said, because it has all too often been the basis of private decision-making, that in principle, and at high discount rates, larger immediate benefits can have a greater present value than a smaller stream of benefits continuing in

perpetuity. This, of course, would seem to justify in some cases at least conceptually the pillaging and near destruction of a fishery through high fishing effort, particularly for private operators, and where the fishing effort is thought to be able to switch subsequently to another fishery. Table I illustrates a hypothetical instance where the Present Value, and by implication, Rate of Return on the capital investment, is higher if the resource is fished to near exhaustion over ten years, than if the resource is maintained in perpetuity through limitation of catches to Maximum Sustainable Yield.

The flaw in this argument is that the use of discounting methods expresses the present worth of a project to present people in a specified economic environment. It says nothing about the worth, or otherwise, of a present project to future people, whose calculus with respect to such a project would be quite different. It may reasonably be argued from the theory of Consumers Surplus that future generations would prefer some fish to no fish at all, and at the expense, i.e.,foregone consumption, of the present generation.

Table I

Illustration

Maximum Sustainable Net Benefit (Yield minus Costs) = 100
Rate of Interest = 20 percent ∴ Present Value of perpetuity = $100 \times \frac{1}{.2} = 500$
Given Maximum Effort assume Net Benefit would be:

	Benefit	Discount Factor	Present Value
Year 1	200	.833	167
Year 2	180	.694	125
Year 3	160	.579	93
Year 4	150	.482	72
Year 5	100	.402	40
Year 6	80	.335	27
Year 7	60	.279	17
Year 8	40	.232	9
Year 9	20	.194	4
Year 10 End of Fishery			554

This is only worth mentioning to illustrate that investment appraisal methods are merely techniques of analysis and exposition and give only a rather superficial 'economic' justification for particular projects. It may be safely said that, particularly for governments and other continuing social institutions, the aim of fisheries policy on economic as well as ethical grounds, should be the maintenance of the biological resource and specific projects for the total development of a fishery should, likewise, not seek to exceed the limit of Maximum Sustainable Yield. As stated earlier, however, where a fishery is shared, especially between different nations, incremental projects which exceed Maximum Sustainable Yield may be economically justifiable to the country or project sponsor concerned.

1.3.2 Perishability

The other principal characteristic of fisheries is the highly perishable nature of the resource once it is removed from its natural environment. Both bacteria and enzyme action rapidly spoil the edible flesh of the fish, especially at the higher temperatures of most developing countries. As a result, both speed and careful handling are necessary in the distribution process, and this causes substantially higher costs than in, for instance, the distribution of most foods of agricultural origin. Fish is, similarly, difficult and expensive to store over time. Except for the more sophisticated, modern vessels, the spoilage characteristics of fish impose constraints on the range and operational features of the catching vessels, and often necessitates a larger crew for fish gutting and handling than would be required for the task of handling the fishing gear itself.

The implications of the rapid spoilage of fish on the structure of fishing industries are manifold. Except where fresh fish is sold immediately to consumers, rather complicated systems are needed for its transport, storage and final distribution. At its most elementary, it involves small artisanal

fishermen in simple smoking and drying operations prior to distribution. At more industrial levels, it involves the provision of ice plants, cold stores, transport facilities, etc., and hence, the creation of substantial marketing infrastructure. Perhaps its most pervasive effect in developing countries is the poor market situation and bargaining power of the catcher, who must sell his catch upon landing and from this situation follows the sequence of fishermen's indebtedness to middlemen, lack of finance for improving methods, and low incomes.

1.3.3 Market factors

As a basic foodstuff, the demand for fish is, in general, said to be relatively inelastic with respect to changes in prices and incomes. Whilst this may be generally true of markets in developed countries, a primary cause in developing countries is, more probably, the relatively inflexible capacity and bottlenecks of the distributive system. Because of its special characteristics and its perishability, fish is most often, except perhaps in its dried state, distributed through separate channels from other principal food items; either through specialist traders and shops for fresh fish, or through cold stores. This relatively specialized and constricted channel most often makes it difficult to cope with the inevitable daily variations in supplies, with consequently large variations in prices and alternate gluts and shortages. Whatever the reason, direct markets for fish for human consumption show great instability.

1.3.4 Location

The vast majority of fish catches are taken by vessels at sea and this implies that their bases of operation must be on the coast, frequently at some distance from their markets in the main centres of population. Both the economics of vessel operation, i.e., the ratio of time actually spent fishing to total time, and the need to avoid spoilage of the catch, dictate that fishing bases shall be as near the fishing grounds as is practically possible. The natural coastal environment is frequently not well adapted to the functions of fishing bases and may necessitate expensive protective works, or dredging, as well as substantial communications facilities. In many countries too the coastal areas are less well economically developed or populated than the principal centres of economic activity, and fisheries development is often seen by governments as a means of ameliorating regional imbalances.

1.4 The Special Features of Fisheries Projects

These special characteristics of fishery industries, be they artisanal or more highly developed and sophisticated, have an important influence upon the nature of development projects in the fisheries sector.

There are, of course, great variations in circumstances; some fisheries are highly stable from a landings point of view, supplying stable and well established markets from harbours located at the hub of general economic activity, but, in general, the following points ought to receive special consideration in the design and appraisal of fisheries projects.

1. If a fishing operation is profitable, the fishery will tend to expand, if not otherwise controlled. Since the resource is common property, future yields (catches per Unit Effort) will tend to be lower than current levels, and allowance should be made for this in forecasting.

2. Having regard to the possibly great variability, both daily and yearly, of yields and of prices, forecasts of net benefits are subject to a relatively large range of uncertainty. For this reason, sensitivity analysis is of particular importance in fisheries.

3. Efforts should be made to ensure that a project is "complete" in the sense that all necessary inputs are available, either within the project or from existing sources. A fishery operation involves a wide variety of capital and other inputs, for the catching and subsequent phases, and for infrastructure, and an assurance that these will be forthcoming is necessary.

4. For the above reason, all marine fisheries projects, even those confined to the marketing or processing phases, should include an evaluation of the projects effect upon the vessels' economic position.

5. If, as we argue, a fishing base, harbour or terminal, is a complex interface between the catching and subsequent phases, considerable care should be taken in the distribution of infrastructural costs. On a strictly financial basis, vessel operations frequently cannot bear the full costs of infrastructure, particularly harbour development. One should take into consideration that the benefits frequently accrue to subsequent phases in increased supplies or better quality when price mechanisms are imperfect.

6. Where fish is a food of very important nutritional significance in the internal market of most developing countries, and because, on the other hand, modern fishing technology, engines and vessels and equipment, not to mention fuel, have most often to be imported, the foreign exchange effect of fisheries projects is most important.

7. Due to the effects of variability of supplies, the optimal design capacities of large capital inputs, such as processing plants should be carefully considered and break-even throughputs established. Annual excess capacity may be tolerated in some cases but for most developing countries it is a luxury they can ill afford.

CHAPTER II - Project Identification and Formulation

2.1 Fishery Planning and Fishery Projects

As we observed in the Introduction, project preparation is a progression from the general to the particular, and in this, the first steps, those of project identification are crucial. Once the main outlines of a project are decided, formulation and appraisal follow well defined, logical steps, requiring principally technical logic, care and consistency in estimates and the application of straightforward appraisal techniques. The trick is to get the right project of approximately the right dimensions in the first place. Further, it is usually at this stage that attempts are made to interest government departments, investors and financing institutions in the project, and to secure financing for full project formulation and appraisal. Experience has shown that in many developing countries, fisheries administrations often have difficulty in convincing ministries of finance, or planning agencies of the worth of fisheries projects, and many potentially good projects have failed to obtain support through poor initial presentation of expected social, economic and financial results. The government financing and planning agencies themselves need to have well prepared project proposals if they are to convince international banks or bilateral donors, who are now insisting on certain minimum standards of presentation and analysis. We define this stage in the process as pre-feasibility studies.

The idea, or concept, of a possible project may come from a variety of sources. At its most direct, it may arise from the observation of a potential investor that a fishable resource exists, or may be expanded, or from similar intuitions by government or FAO field staff concerned with fisheries. It will perhaps as often arise from the realization of "bottlenecks", or constraints to development, whose elimination will have clearly beneficial results.

It may, on the other hand, emerge from the planning programme of the government. If it has been decided that priority should be given to, say, food production, or increased exports, planners seek to identify, on general and macro-economic grounds, sectors capable of achieving these objectives, and a fisheries sectoral plan will provide specific indications of the general types of projects and supporting resources which will be available. The task of the project analyst in these circumstances is to identify technical possibilities for investment contributing to these objectives.

Whichever way the project comes to be initiated, it will be clear that it must conform to the government's economic and social priorities, and its development strategy, if proper and effective use is to be made of scarce resources. This applies not only to the choice of a particular project itself, but often to its technical characteristics. If foreign exchange is scarce and carefully budgeted, this may dictate, for instance, a project with minimum import content, as for instance small wooden vessels and simple processing, rather than a possibly more technically efficient project with large imported vessels and freezing plants. The technique of shadow pricing described later helps to elucidate these matters.

It will be apparent that fisheries planning and project identification and formulation are not separate and unrelated activities. Whilst a fisheries sectoral plan will take into account a much wider range of factors, economic, political and social, than the project identification activity, it must, if it is to be practically effective, take into account resource constraints, technically possible solutions and their comparative economic feasibilities. A bad plan will almost always result in bad projects, whereas a good plan will at least get the priorities right for the process of project identification. This is essentially to say that there must be a considerable degree of "feed-back" in the process of project identification and fisheries planning, both involving the trial and error solutions of alternative technically feasible possibilities.

More detailed planning studies will narrow the range of acceptable projects and more clearly define the projects or the type of projects necessary for plan implementation, be they in the production, marketing or infrastructure sub-sectors. These may, formally or informally, be grouped in mutually supporting or inter-related programmes for which general and financial approval will be sought.

The better and more comprehensively this work is carried out, the more precise becomes the task of the project analyst, and the less the need to review all possible investment activities.

Where such guidelines do not exist, or are ignored, the number of possible projects may be very large, and make the task of comparative evaluation near impossible, if only through sheer volume of work, with the result that projects may be selected on a largely random basis or because of some superficial attractions. Equally, no project can really be selected on purely internal economic considerations. Social, employment, and political factors have to be considered, and it is clearly better that this should be done at national economy level by personnel specializing in this task. As a particular

example of this, for instance, proper use of social benefit analysis requires a knowledge of the Social Rate of Time Preference, i.e., how the society as a whole evaluates future benefits as against present benefits. This is not simply an outcome of present consumers' preferences. Governments, as custodians of the public welfare, have long-term strategies for economic and social development which are also valid determinants of the social investment process. It is very difficult, if not impossible, for the analyst at the project level to determine this figure with any validity and it must be sought from the planning or finance ministries.

For the remainder of this discussion it is assumed that some type of fisheries sectoral plan exists, if only, at minimum, certain policy guidelines for investment in food production, exports, regional employment policies, etc.

2.2 Stages in Project Formulation and Analysis

Given some guidance, formal or informal, as described in the preceding section, the task of the fisheries project analyst is to discover and define that set of projects which will give the best returns to necessarily limited investment resources, whilst conforming to biological, technical and social constraints.

At the same time "best returns" have to be considered from some rather differing viewpoints; those of the government, or the effect on social welfare, those of the private or institutional investor, and those of the fishermen and other manpower to be involved in the project.

As conventionally described (FAO) this process is carried through in three distinct, though related phases:

1. Project identification and pre-feasibility
2. Project formulation (detailed)
3. Project analysis and appraisal

In Stage 1 a wide variety of possible technical solutions to achieve a given objective may be considered, their main outlines defined, and necessarily summary consideration given to their comparative advantages and disadvantages, with the objective of establishing the best one, or their relative rankings under various criteria. At this stage, the best, or perhaps two or three alternatives will be selected for more detailed study.

In Stage 2 the selected projects will be given specific and detailed form, from which the quantities and cost of all inputs and outputs may be calculated, the operating characteristics and design parameters established.

In Stage 3 the designed project(s) are analysed from the various points of view, comparisons made, and the results displayed, with all supporting information, upon which a decision to proceed, or to seek financing, can be made by the various parties concerned.

In practice, the three stages cannot be sharply distinguished with respect to the work and techniques involved. Some projects, for instance, may involve in Stage 1 as detailed a consideration of particularly uncertain or difficult aspects as, in another project, would be appropriate to Stage 2. Similarly, the analyses described later, principally for use in Stage 3 may often be necessary in Stage 2 to determine optimal design parameters, or assist in the choice of appropriate technology.

It is probably more true to say that, for a successful project, carried through to execution, the stages of analysis are interlocking and continuous up to the point where the decision to invest is undertaken.

The real issue is in the complexity of the decision process and in the frequently substantial cost of Stages 2 and 3, particularly for infrastructural projects. A successful project requires, most often and especially in developing countries, a fairly wide consensus of opinion about the worth of a project from various departments of government, from potential financing institutions such as the regional banks, from private investors, and, often, from foreign private enterprises.

Having regard to the inevitable costs of design studies, site investigations, substantial market research, etc., a decision to commit pre-project funds for detailed preparation and analysis must depend upon a comprehensive initial assessment, for which much necessary information is lacking, and which therefore must be convincing to a wide variety of interests, on the basis of less than complete data.

It also has to discriminate between a number of alternative projects, since the costs of detailed preparation for all possibilities would be prohibitive.

For these reasons, Stage 1, Project identification and pre-feasibility, is of paramount importance, from which follow Stages 2 and 3, if not simply, at least logically and in detail, with the prior support and assistance of the interested parties. It has been too often the case that fisheries development has been checked, or not fully realized, more through poor project identification and the failure to convince government departments and financing agencies, than through shortcomings in Stages 2 and 3. For this reason we shall pay relatively more attention to the problems of identification and pre-feasibility studies than to project formulation and appraisal.

2.3 Project Identification and Pre-Feasibility Studies

We are trying in this section to distinguish between fisheries project identification and preparation, and the wider field of general fisheries planning. It will be realized however that a complete separation is not possible. Project identification must be preceded by what is, in effect, if not formally, a planning study to identify the priority fisheries sub-sectors, and define the fisheries environment. If this has already been done in the plan, so much the better, but if not, the project proposal must include a review of the situation and a discussion of the relevance of the proposed project to national objectives.

2.3.1 Importance of "Objective"

The fisheries development strategy, and the projects which constitute it, must conform to the objectives of national economic development, and it is of great importance that these objectives are clearly understood by the project analyst. Should the fisheries development strategy seek to maximize its contribution to Gross Domestic Product, or to produce more food for local consumption, or maximize foreign exchange earnings, or import savings? These questions are often important, not only for the selection of the correct type of project, but often of relevance to their technical features. There are clearly many cases where maximum employment effect has to be evaluated against, for instance, capital-intensive imported technology, and questions of this nature can only be decided in the light of national economic policies and goals, and not on purely fishery considerations.

The objective will frequently define the priority fishery sub-sectors, etc., for which projects will have priority.

2.3.2 Inventory and analysis (sectoral review)

Given this understanding of the national economic situation, the project identification study begins with a thorough review of the fisheries sector in order to provide basic information for project preparation, to define the resources available (the development potential), identify constraints to development and the technical options available generally, to define the project environment.

This inventory should clearly start from the biological aspect for which all available information on the size and species composition of the available stocks of marine resources should be reviewed, together with data on the marine environment.

The existing fleets and types of vessels should be reviewed, as also existing markets and methods of processing, as well as administrative and institutional structures.

The type of information required is discussed in the next section. Appendix I outlines the type of scrutiny to which the information should be subjected.

In many cases there will be a lack of adequate statistics, particularly time series, for such a description of the existing sector situation and recourse may be had to qualitative evaluation where necessary. It is however very important that such a subjective process be carried out by persons with an intimate and detailed knowledge of the actual situation.

2.3.3 Constraints on fisheries development

The situation of the fisheries sector, as revealed in this review, must now be carefully examined to determine the particular constraints on development. It is suggested that this screening process be carried out under the following headings, which are not necessarily mutually exclusive:

(a) Biological resource bases

The review data on the extent and composition of the marine resources available should be examined in some depth in order to establish whether existing operations, including where appropriate foreign fleets, are fully exploiting them or what opportunities exist for an increase in fishing effort.

In this context "fully" has perhaps to be defined. In an ideal world of managed fisheries this would have to be taken as Maximum Sustainable Yield. In practice, some judgement is necessary and "fully" should be taken as "fished at that level where additional effort would not be economically justifiable in terms of costs and returns and where additional effort would cause concern about the future levels of Catch per Unit Effort".

Particular attention should be paid to those situations, e.g., Aquaculture, Fish Farming, etc., where the resource base is capable of man-made modification, as also those situations, e.g., shrimp by-catch, where the harvested resource is not fully utilized.

The commercial features of the fish should be carefully defined, oil content, filleting yields, colour and flavour, spoilage characteristics, etc., and their seasonal variations.

(b) Environmental factors

Closely related to the biological base in some cases, this covers such matters as weather and sea states, distances from port, seasonal movements, the availability of water and of labour, nature of sea bottom, tides and currents.

(c) Market factors

Size, type and location of existing markets for different types of fish and fish products. Capacity and structure of existing marketing channels, utilization of fish landings. Market power of merchants and fishermen's indebtedness. Position of fish products in the national diet. Imports and/or exports of fish products, and future market prospects.

(d) Infrastructure

Types and capacity of existing fishing ports and landing places. Adequacy of landing and servicing facilities. Ship and boat building and repair facilities. Roads and transport facilities. Water, power and other facilities. Supply of physical inputs to the fishing sector, nets and gear, salt, boxes, etc.

(e) Technology

Critical examination of technology in use, ships, gear, methods of fishing and processing. Review of existing and available alternative methods and equipment. Status of research and information/extension services.

(f) Institutions and policy

The government's position on fishery limits and fishery resource management. Its willingness to envisage foreign or joint venture participation. Adequacy of local fisheries administration and government services to the fisheries sector. Fisheries institutions such as cooperatives and a cooperative law, local associations. The legal status of marine and inland waters. The training of human resources.

(g) Financial resources

The review of the fisheries sector should include consideration of its industrial structure and the financial strength of its various elements including special problems, as may be, artisanal fishermen's indebtedness. The foreign exchange situation should be considered, as should the government's status with various sources of foreign financing and its current ability to finance both direct investment in projects, or the necessary infrastructural services such as training, research-extension, marketing services, etc.

The purpose of this review, in conjunction with the national objectives, is to define the priority sub-sectors of fisheries development potential. It is difficult to be categorical about the procedures since the fishery situation will vary enormously from one country to another, as will the national economic circumstances.

However the procedure, as briefly outlined, will broadly identify areas of opportunity for further development either through, say, expansion of the fisheries on to hitherto underutilized resources, or through the removal of bottlenecks and constraints in the existing industry, its methods, organization or markets.

The only really general rule is that the sub-sectors so defined should:

(a) have an adequate biological resource basis to sustain them in future years;

(b) be capable of development with existing and proved technology;

(c) be within the ability of the government to finance and implement the projects arising, having regard also to human resource and institutional limitations.

Some technically feasible possibilities may be discarded at this stage on overriding considerations of scarcity of real resources.

It may be useful at this stage to categorize the sub-sectors of potential (priority) as follows:

(a) Those permitting expansion of landings of fish through more intensive fishing effort

(b) Those reducing costs through improvements in technology

(c) Those permitting an increase in export or import substitution

(d) Those capable of increasing employment

(e) Those capable of contributing to regional development goals

(f) Those in need of, and capable of profiting by, research, surveys or institutional development

The ranking of the priority sub-sectors at this stage is necessary since not all can be undertaken at once, or even at all. The work of project identification and formulation must concentrate upon those few sub-sectors promising most development potential and those most in accordance with the government's view of the needs of the national situation. This is in essence a political decision on the general and fisheries development strategy. However the review will make the situation clearer and aid in explicit decision-making before project identification proper begins.

2.4 Project identification and selection

What has so far been discussed in this Chapter is largely concerned with "planning" as opposed to project identification but it is a necessary part of the total process. It may well have been undertaken as part of the fisheries sector plan before the project analyst, as such, begins his work.

We have arrived at a point where we have a set of priority areas in the fisheries sector conforming to national goals and the realities of the fisheries situation. The task now is to identify and, in a general and relatively qualitative way, justify a particular project involving investment for the selected priority areas.

If all the necessary data were available and it were a straightforward matter to design an optimal project in detail, there is no reason, in principle, why one should not proceed to final project formulation. However this is not generally so.

In the first place, the preparation of a detailed project and its appraisal as a basis for the investment decision most often will involve significant costs in research and investigations in design studies and the preparation of forecasts. The incurring of these costs has first to be justified.

Secondly, in most cases, a decision to proceed with a project involves its acceptance, as the best course of action, by a number of separate decision-makers, various government departments, such as those concerned with fisheries, the planning agencies, ministries of finance and/or economic development, as well as the sources of finance and other necessary inputs. It is necessary that differences between these interests be reconciled before detailed project preparation takes place, adequate preparatory finance secured and initial steps taken to secure investment funds. This is done through initial project identification and pre-feasibility studies.

In addition to the sector review already undertaken, there will be additional sources of data and information for project identification, such as:

(a) Reports of FAO/UNDP field projects

(b) International bank sector review and project identification mission reports

(c) Special studies by government departments and consultants

The task is to select for each priority sector, a project, or set of projects, which achieve given objectives and which, on general grounds, can be shown to justify further detailed preparation and appraisal.

It is impossible to set down a definite and unique method for doing this. A priori, there are a number of options available and to select the most appropriate is necessarily a trial and error process involving the comparison of alternative technical and economic possibilities, rejecting those which fail to meet required conditions and ending with two or three alternative formulations for further detailed study.

It should be appreciated that, at this stage, within a given priority sub-sector, how wide the choice is. It is not confined to alternative technical formulations of a particular activity, such as fish catching or port construction, but is rather often a comparison of totally different approaches to a problem, e.g., is it better to build new ships, or improve marketing methods, or introduce new products,and for each of these there will be alternative technical possibilities.

This necessarily involves marking a feasibility study of the alternatives chosen so that unfeasible or less attractive possibilities can be discarded. Lacking adequate data and time, this most often has to be done on a qualitative basis.

Some general observations may however be made.

2.4.1 Immediacy

We are discussing the choice of investment projects, i.e., the investment of capital in activities with a quantifiable pay-off which can be undertaken now, with existing knowledge and the state of the arts. If a proposed project requires a lengthy pre-investment period of research and technical development, it cannot be regarded as a current investment opportunity. Its prospects may fully justify a pre-investment project but this should be justified on general grounds separately from the project identification activity. Much the same reasoning applies to desirable expenditure, say,on training or improvements in administration, which do not have an easily quantifiable pay-off.

2.4.2 Objective

As with the fisheries sector review discussed earlier, the "objective" of the development strategy should be constantly kept in mind in comparing alternative projects. This will often influence a choice of location, or of high versus low capital intensity for example.

2.4.3 Data limitations

In the preliminary identification stage much desirable information will be lacking and it is necessary to estimate important figures relating to the values of inputs and outputs of the project, technical conversion coefficients and yields, etc. It is not generally possible at this stage to undertake the full range of inquiries and information-gathering, market research and cost analysis, to provide definite answers for a number of alternative project formulations. Best use has therefore to be made of available "yardstick" information backed by the informed experience of the project identification team. World market prices of most inputs and outputs are generally readily available and transport and insurance costs can be assessed fairly easily. Local costs, especially of labour and locally produced inputs, frequently pose problems but comparisons with similar occupations and products provide a guide. Labour costs should be entered at rates likely to have to be paid and due allowance made for recruitment and training expenses. It is frequently a source of error to assume that, because there is much local unemployment or underemployment, necessary labour costs will be particularly low. Since the object at this stage is to assess the financial feasibility of alternative projects, taxes and social security payments should be included in costs. In the absence of any better existing data, information concerning the technical characteristics of the vessels or process, such as fuel consumptions, filleting yields, freezing times, etc., may be taken from manufacturers' specifications provided due allowance is made for local operating conditions, i.e., difficulties of maintenance, characteristics of raw material, etc.

Almost any project will be feasible and profitable if the sales volume or selling price is set sufficiently high and, in the absence of detailed market information, this has often proved something of a temptation and a trap, and some care should be taken to temper optimism with realism on this score.

However the principal object, at this stage, is less to define a specific project than to identify, from a small number of alternative possibilities, most commonly, alternative for mutations of the same project idea, that one most likely to meet given objectives and most meriting further study and preparation. Provided that the technical and economic differences between the alternatives are made clear, the use of partial and yardstick data will not normally give rise to serious errors in ranking. It must, however, be pointed out that relative prices of inputs and outputs have an important effect upon the desirable technical characteristics of a project, no less than the purely engineering or technological factors and care should be taken to get the information as accurately as possible, whilst appreciating its limitations. For this reason, as well as others, the project finally selected for detailed preparation should not be regarded as fixed and immutable in its main outline. Better and more comprehensive information at the project formulation stage may well dictate substantial changes in the original concept.

Assuming that the sectoral priorities have already been determined in the plan or earlier review, the short list of alternative projects, or alternative project formulations, must now be compared and assessed. Some may indeed be readily discarded on grounds of lack of financial profitability, technical feasibility etc., but the rest must be presented to higher authorities for decision. The problem is normally that no one project is markedly superior to all others in all respects. If this should be so there is no problem and the "best" project can be recommended without reservation. Typically however, one project may have the best financial prospects, another the best employment effect, another more consonant with available managerial capacities, etc., and all with varying degrees of risk and financial demands. It is not, in principle, the job of the project analyst, per se, to make the decision, though of course, he may offer advice, and, if properly briefed in his terms of reference as to political and development objectives, make recommendations.

The results of the identification study should be presented in an orderly and logical way. It should be kept in mind that the purpose of the work is both to permit a rational decision about the use of scarce national resources, and to help establish a consensus of support for the prosecution of the project eventually chosen. The report should therefore review the economic and developmental background, the current fisheries situation and the objectives of fisheries development in the national situation. The chosen projects and their alternatives should then be described in a narrative way and comparisons drawn between them.

At this stage, as compared with the later project formulation stage, the principal contrasts to be made, as far as they can be calculated reasonably firmly, are:

(a) Capital costs

(b) Foreign exchange costs

(c) Financial profitability in the form preferably of internal rate of return

(d) Employment effect

(e) Nutrition effect

(f) Import/export balance

(g) Managerial requirements

(h) Required infrastructure and government services

(i) Possible external effects, spin-off, linkages, etc.

These should be discussed and compared in a narrative and qualitative way supplemented by a tabular presentation.

Some writers would say that for sound decision-making the identification/pre-feasibility study should analyse in some detail the social costs and benefits of the project and its detailed effect upon the foreign exchange balance, etc. Certainly these aspects should be discussed in a narrative way, but because of time and data limitations, it is not usually desirable to do this at the identification stage for a number of alternatives. This is particularly so for projects formed under the auspices, or with

the interests of the FAO/UNDP system or the international banks, because it is certain that all projects will come under a great deal of subsequent scrutiny through preparation and appraisal missions. It is therefore not recommended that detailed breakdowns of costs and benefits be essayed at the identification/pre-feasibility study stage.

2.5 Selection

Two situations must be distinguished: one where the alternative projects are mutually exclusive, i.e., where only one can be chosen, and the other situation where, given the availability of resources, more than one project may be selected. The former most often arises in relation to a particular constraint or bottleneck which it is desired to remove, whereas the latter most often occurs in a general survey of development possibilities.

2.5.1 Mutually exclusive projects

These usually arise in the form where the alternatives are different formulations to achieve the same objective, be it exploitation of a fish resource, or a particular market, etc. The alternatives may be ranked in terms of particular characteristics to assist in the choice, but no overall system of ranking has any validity. The "best" project is that which remains after others have been discarded on various grounds. Since financial viability is a necessary condition for success and to the extent that the alternatives are more technical variants rather than totally different project concepts, it will be necessary to choose an alternative with a positive rate of return, due allowance being made for risk and manageability. Given this, regard will be had for employment effect, or foreign exchange effect, etc., depending upon the development strategy.

2.5.2 Non-mutually exclusive projects

The problem for governments in their development strategies is different from that of the private firm whose primary concern may be taken here to be with the Internal Rate of Return of a project and its associated risks. Governments have to have regard to a much wider range of effects upon the economy and for this reason the Internal Rate of Return cannot be the sole criterion in ranking projects for selection. Whilst a positive financial rate of return is highly desirable in all cases, it is possible to conceive of basic infrastructural projects with great social benefits, acceptable with very low rates of return, if governments are prepared to meet operating deficits. Again, which projects are acceptable on various criteria of profitability, employment, balance of trade grounds, etc., is a political and strategy decision. All the analyst can do is to rank the attractiveness of the projects under the various criteria.

These projects, alternative formulations for the use of scarce resources, must be displayed in a form which assist in the final choice. This is best done by ranking the alternatives under various headings, principal among which are those given earlier. As mentioned earlier, this necessarily involves some degree of feasibility analysis, discussed in a later section. Following established FAO practice for agricultural projects[1] this is perhaps best done by considering and ranking, the alternatives under the following general headings:

1. From the technical point of view

   (a) Which alternative has the least technological complications, employing proven and established technology readily available

   (b) The least dislocation to established practices of fishermen and processes

   (c) The best adaptation to the characteristics of the fishery resource

2. From the financial point of view

   (a) Capital and operating costs

   (b) The best cash flow

1/ General Guidelines to the Analysis of Agricultural Production Projects. Agricultural Planning Studies No. 14

(c) The best Internal Financial Return (see page 19)

(d) The foreign exchange balance

(e) Need for continuing government finance

3. From the general and economic point of view

(a) Shortest capital recovery period

(b) Maximum possibilities of linkages, spin-off and other external economies

(c) The best internal/economic return (see page 19)

4. From the management and organizational point of view

(a) The simplest and least complicated management organization

(b) Minimum dependence upon new institution building, e.g., financing organizations, cooperatives, expansion of government services

(c) Minimum training element and the need to acquire new skills

5. Relationship to other projects

Where a country has pressing problems of, say, foreign exchange, or regional underdevelopment, special consideration should be given to the effect of the proposed fisheries projects upon other government programmes in these fields. In many cases undoubted advantages of one project in terms of financial return or other direct economic benefits may have to be sacrificed to overriding needs for import saving or foreign exchange earnings, or, alternatively, for the employment and development effects in particularly disadvantaged regions, and this, not only from political considerations, but also from longer-term views of development strategy.

Fortunately, in any given sub-sector, or in respect of a particular constraint or bottleneck, one project variant will often appear to be superior to others on the major counts and this one will be chosen. Where this is not the case, a process of discussion and compromise must be undertaken with the different interests concerned, fisheries, finance, planning, etc., and the decision often taken at the highest political level. Further research and investigation on particular aspects may have to be made, but, in the final outcome, a decision will be made, in principle at least, to proceed with one of the alternative project formulations proposed with perhaps a small number of alternative variants for comparison.

It is at this point that attention should be given to the future financing of the project and the interest of investors and financing agencies enlisted who, from their experience of past projects and their financial regulations, will be able to offer great help in the selection process.

The essence therefore of good project identification and pre-feasibility studies procedures is:

1. A comprehensive review and analysis of the existing fisheries situation, identification of constraints and bottlenecks, and of opportunities for development

2. A narrative discussion of all possible actions and projects

3. A selection of the most promising project concepts for further examination

4. The construction of alternative outline projects, using such data as available, including standard or yardstick prices for costs of inputs and outputs and manufacturers' general specifications for production data

5. The ranking of such projects under the various headings mentioned above, including recommendations as to the final choice

6. An account of the expected effects and costs of the project, difficulties to be expected and associated measures to deal with them.

It has to be said that this process is to some extent hit or miss - a first logical approximation. First, a great deal depends upon the technical competence and thoroughness of the project identification team. It is not normally possible to mount a full range of expertise for the identification stage, since the range of possible options may be very large. The absence of, for instance, a civil engineer or a gear specialist, may cause a promising project variant to be omitted from consideration. Similarly, the inclusion of certain types of expertise, say, a naval architect, or marketing specialist may cause undue emphasis on the ship or marketing aspects of development at the expense of other promising possibilities. As a general rule the project analyst, or team leader, should be an economist with a wide general background in fisheries. The essence of economics as a discipline is the study of the use of scarce resources to satisfy a multiplicity of desirable ends. The analysis and choice between desirable development policies and the projects to implement them is essentially an economic problem, and, given an adequate technical background of experience, the economist is probably best qualified to coordinate and mediate between more technical specialists.

Secondly, a potentially good project may be undervalued for a variety of reasons, for example poorly chosen technological characteristics, the wrong size or type of vessels or machinery in the absence of detailed and expensive design studies.

Commonly, the relative prices of inputs and outputs can alter the balance between alternative projects. As between high and low technology projects, estimates of capital and/or labour costs, can be critical. Further estimates of the costs of inputs and outputs are time-consuming and frequently not too necessary in detail for mutually exclusive projects.

However, a complete assessment of all possible projects and their variants is not possible in the absence of complete and detailed information. All we can hope to do is be logical and systematic in our first approach and trust in the technical ability and experience of the project identification team.

Both pre-feasibility and project formulation studies require much the same information and, where possible, the same analytic techniques, though the latter are needed in more detail and sophistication. Much of what is discussed in the following section therefore is applicable to project identification and pre-feasibility studies, particularly the use of the short methods of financial appraisal.

2.6 Presentation - Project Identification and Pre-Feasibility Studies

The results of the foregoing study should be presented in a neat, concise and logical way, with the twofold object of:

(i) enabling and assisting the government, or project sponsors, arrive at a decision as to the choice of project and

(ii) enlist the interest and support of financing and other associated agencies, both for detailed project preparation and for ultimate financing of the project.

The report should deal, at minimum, with the following substantive sections:

(a) National economy and development objectives

Review of the national economic situation as it relates to the fisheries sector, foreign exchange position, population growth, alternative sectors of economic growth, regional problems, etc. Much of this may be taken from national planning publications, the terms of reference of the project team and general background reading, including FAO and Bank country reviews, etc.

(b) Fisheries Sector Review

This should give a comprehensive and critical review of the existing fisheries situation, its problems and constraints, the available resource basis, legal status of the fisheries, market prospects, fish contribution to nutrition and exports, past projects and aid assistance in fisheries, foreign participation, etc. Deficiencies in existing institutions and in available data should be mentioned. Special attention should be paid to infrastructural facilities, or their lack, i.e., harbours, landing places, roads, etc.

(c) Selection of project(s)

There should be a narrative discussion of all possible approaches to fisheries development and the wide variety of possible projects, adducing reasons for the summary dismissal and neglect of some, and the general, strategic reasons for choosing a small number for detailed study.

This discussion should of course, relate to the arguments of the previous two sections. The reason for this section is to dispose, as far as possible, of subsequent suggestions and argument as to overlooked projects, or pet departmental interests, and focus attention on the project(s) proposed for further study and preparation.

(d) Description of project

The project selected should now be described in as full detail as possible, together with, if any, the alternatives for comparison. The description should describe the objectives of the project, its expected results in physical terms, the physical inputs and outputs, its timing, its relation to the existing industry and to other projects. Special problems of implementation and steps necessary to overcome them should be mentioned. Longer term aspects as to changes in prices or demand should be assessed, as should organizational requirements, management, government services, land acquisition, etc. Social benefits and possibilities of other favourable effects arising from the project should also be set out.

(e) Financial statement

The foregoing section should be as comprehensive as possible, contrasting, where necessary, the alternative project formulations. The present section, within the limitations of the data available, should show the initial capital costs of the project,yearly project inputs and outputs, and the net financial returns to be expected.

The principal costs and revenues should be broken down into local and foreign exchange costs and separate balances calculated.

In comparing projects of different types and of different gestation periods, it is desirable, as an index of financial efficiency, to use the Internal Rate of Return. There are however some substantial risks and sources of error in this measure at the present stage. Relatively small errors in estimates of capital costs or in the gestation period of the project can render the Internal Rate of Return quite misleading. Unless the analyst has a high degree of confidence in the data, it is probably better at the start to give the financial position as a straightforward one-typical year trading account, using depreciation and interest on invested capital at common, locally accepted levels and showing the return as a percentage on the total capital invested in the project.

The period of 'Pay-Back' may also be used at this stage as an indicator of financial performance.

Projects, and their variants, may indeed vary in the degree of risk involved, or in their sensitivity to changes in important parameters. It is not however generally worthwhile, at the pre-feasibility stage, to enter into detailed risk and sensitivity analysis, though narrative reference should be made to this point if it is considered important. Similarly,only qualitative assessment of social costs and benefits should be attempted.

(f) Ranking and recommendations

From the foregoing descriptions and analysis it will now be possible to rank the various alternative projects under the various headings earlier discussed. This may often be best done in tabular form. Where one project emerges as superior on all counts there is little problem in making a recommendation. Where such is not the case, final selection will depend upon the sponsors or governments, development strategy and priorities If the project identification team has been well briefed, there is no reason not to make a definite recommendation as to the project to be chosen, as long as it is understood that the final decision is, in effect, a political choice, involving factors outside the competence or terms of reference of the project team.

CHAPTER III - Project Formulation

3.1 Project Design

3.1.1 General

We assume now that a definite choice has been made from the wide range of possible fisheries projects, and a priority project selected. The pre-feasibility studies will have indicated the type and principal dimensions of the project, and have given some indication of its likely financial feasibility. Some alternative formulations of the same project may still be under consideration. The task of the project preparation team is now to define in complete detail the investment project, to measure its costs and returns, and analyse the project from several points of view. Much of the data and the techniques required will have been employed in the pre-feasibility selection stage, and the subjects presently discussed in this chapter are of relevance to the earlier work.

There is, however, a need to take great care not to take the pre-feasibility study as rigid and immutable. Indeed it is often better that the two stages be undertaken by different analysts. Vested interests and professional pride in the earlier study too often may lead to inflexible attitudes in project preparation.

The pre-feasibility study has shown that an investment situation of sufficient priority (probably) exists, and that technical solutions are available. However, new and fuller information directed solely at the project under consideration may require considerable revision of the original ideas.

The task now is to define, dimension and detail a specific investment project on the best estimates of data available, including future trends; to calculate its feasibility from various points of view, and to compare it with other mutually exclusive alternatives where necessary, either in total or in its relevant parts; to estimate the risks and uncertainties involved, and generally to provide enough information and assessment of the proposal and its background so that the investment decision may be taken.

In the following chapter various appraisal methods are discussed and appraisal is generally understood to be a separate and subsequent stage to project formulation. Certainly every project proposal should conclude with a thorough analysis and appraisal of its feasibility. It is, however, well worth making the point that appraisal methods frequently imply a feed-back to the project formulation stage. Many aspects of the project, size, location, type of equipment, for example, can only be determined in the light of appraisal techniques applied partially to particular aspects of the project, as the work proceeds. A great deal of time may be saved by the judicious use of appropriate appraisal methods as the project formulation proceeds stage by stage.

The Guidelines set out in Annexes A and B show the principal matters to be discussed and included in the Project Report and the general form of the report. In this present section we are concerned with certain practical suggestions for use in formulating the project.

First we should distinguish between a project report and a loan application. The latter requires much more detail and information about the sponsors and executors of the project, their financial participation and status, etc., matters which often have not been determined at the stage of the project formulation. It is therefore possible to conceive of "pure" projects, those where no assumptions are made about the source of financing and where the returns on capital are calculated on the total investment, whatever its source, and "structured" projects, where the financing and operating plan is already known. For loan applications, projects must, of course, be "structured", but it is not vitally necessary at the project formulation stage and in this work we shall not pay too much attention to the financing and executive aspects of projects.

There are so many different types of fisheries projects, e.g., artisanal, industrial, catching, processing, marketing, aquaculture, etc., that it is difficult to generalize. However, we take as basic examples:

(a) Projects for catching, processing and marketing food fish,

(b) Fishery harbour projects, or other basic infrastructural facilities,

largely because of the specific problems involved, but it should be noted that practically every project has its special characteristics and circumstances. Indeed, for projects which are ostensibly very similar in type, for example, catching and marketing food fish, the constraints or bottlenecks justifying the project may be very different, requiring different emphasis or treatment. This brings us once again to emphasize the importance of a clear understanding of the "objective" of a project.

3.1.2 Biological factors

Having regard to the basic biological dependence of all fisheries activities upon the Yield per Unit Effort relationship, and in turn, its dependence upon Total Fishing Effort, it is proper to say that all fishery project formulation should begin with a consideration of the resource. The effect of the proposed project, or other expected developments upon expected Catch per Unit Effort, must be carefully assessed. As mentioned earlier, the Maximum Sustainable Yield of the resources available may have some interest as an upper boundary to the size of a project, but its primary importance is as an indicator of the future course of Catch per Unit Effort. Seasonal availability is also of great significance, particularly to processing projects.

Apart from these questions of total yield, the commercial characteristics of the resource upon which the project will depend, must be carefully defined. These include, species composition, size composition, fishing behaviour in relation to various types of gear, oil content or fillet yield, where appropriate, and other commercial characteristics such as colour, texture and any special processing or handling problems, particularly in relation to bacterial or enzyme spoilage.

Having regard to the high cost of many projects, and their crucial dependence on those matters, one is tempted to say that, if good answers to these questions are not available, the project should be put on the shelf until they are, through intensified research and investigation. This, however, in many cases is unnecessarily drastic, and the analyst must do the best he can with the data available. But certainly in such cases of lack of basic information concerning the resource, the project may have to be designed smaller and less specialized than otherwise would be the case.

If the impact of the project, or other anticipated developments upon the future Catch per Unit Effort is negligible, so much the better, but if future yields are expected to change, these estimates should be used at appropriate points in calculating future outputs, costs and returns. There appears, to the writer little point in taking issue in a project formulation with the economic losses involved in exceeding Maximum Sustainable Yield, a matter more properly belonging to fisheries management, planning and policy. In this less than perfect world, the analyst has to prepare his project in the circumstances as they exist, and not as they might conceivably be.

3.1.3 The catching phase

In a catching/marketing project the next point to be considered is the economics of the vessels and the catching operation. If it is primarily, say, a processing project one might next, after the resource, consider the economics of the processing operation necessarily on the basis of existing landings and landed prices and price forecasts. This seems to be acceptable where no changes are expected to be induced in the latter by the project itself. However, at some point, if only for fuel exposition, consideration will need to be given to the vessel economics and changes in yield/cost relationships. It therefore seems better in all cases to consider next the vessel economics. This is particularly so where the project necessarily involves the introduction of new types of vessels or gear, and there is a need to develop design parameters at an early stage, so that design studies and vessel specifications may be undertaken. This foundation study should be undertaken even where the project itself does not directly involve investment in vessels.

The principal matter to be decided in relation to the vessel operating component of the project is the Catch per Cycle Time, translated into costs and returns. This inevitably involves some prior choice as to suitable vessel sizes and designs, choice of technology, etc. In the first instance at least here one can only rely upon experience and informed judgement as to what is required. Alternative solutions may be worked out and compared, through the means of partial analysis. Whilst best quality or selection, or minimum cost per unit of fish landed may all be desirable objectives, they are but partial objectives of the total system, and the vessel operations should be evaluated, with a given common set of prices for inputs and outputs, according to their profitability after depreciation and interest. These latter can be added back for cash flow calculations but their use at this stage enables fair comparisons to be made with vessels, engines and gear of differing useful life spans.

Clearly this is to some extent a trial and error process, and can only be done by partial analysis to find a solution to be embodied in the project. It should be noted that five vessel types, three kinds of gear, and four trip lengths give 60 possible combinations, not all of which can be evaluated for the project as a whole.

Experience has shown the need to be very realistic about probable fishing time per year. The fishing cycle is made up of the following elements:

(a) Days for Repairs and Maintenance, Surveys, etc.,

(b) Necessary Days in Port for Discharging, Crew Rest, etc.,

(c) Days in Port for Bad Weather, or other adverse fishing conditions,

(d) Days at Sea, which is 365 minus ((a) plus (b) plus (c)),

(e) Days spent Steaming, Moving Fishing Grounds and Searching for Fish,

(f) Fishing Days, is (d) minus (e).

For many steady fisheries, such as trawling, F x Catch per Day equals Annual Catch, though for some fisheries involving much searching, e.g., tuna purse seining, Fishing Days times a factor of fishing hours per day, times catch per hours fishing, may give a better estimate of annual catch.

For the sake of accuracy, these estimates should be made on a monthly or seasonal basis, and aggregated to obtain the annual catch per vessel.

Catch per day (or per hour) per vessel, of course, depends in part on the size and power of the vessel, the size and type of gear, etc., and it is often difficult to estimate these values in the absence of commercial fishing experience. The works of Gulland[1] and of Engvall[2] and Engström will give some guidance in estimating appropriate values for different sizes of vessels from research results or commercial fishing trials.

3.1.4 Costs

In the identification stage, yardstick cost estimates will have been used, but if the project under preparation involves different sizes of types of vessels from those in current use, we now have need of detailed cost estimates. We are now, of course, concerned with the preparation of a detailed project for financing and need to be very specific about the physical inputs. We need to know propulsion costs, gear costs, size and remuneration of crew, etc. These data may be sought from manufacturers, if stock boats are envisaged, or by means of a detailed design study, some of the main parameters for which will have emerged from earlier considerations. At this point the services of a naval architect or experienced vessel operator are highly desirable.

Due to the great diversity of fishing operations it is difficult to generalize about the form of the Vessel Costs and Returns Statement, and FAO has not proposed one. A discussion will be found in Ovenden[3]. It is useful however to seek standardization wherever possible, and a suggested Outline Vessel Costs and Earnings Statement is given in Appendix II. For ready and, as it were, instantaneous comparison of alternatives, it includes Depreciation and Interest. However, for any final choice between alternatives, these should be added back to give the Annual Cash Flow, and discounting methods used.

3.1.5 Crew costs

For a given vessel, it will be relatively easy to determine the number and types of crew. Where the project envisages expatriate officers or crew, due provision should be made to separate their earnings in local and foreign currencies, though these must be shown in the same units in the Costs and Earnings Statement.

For local crew members, current fishermen's wages or shares systems should be employed, but for a new fishery, or new vessels, necessary crew costs will need to be estimated from a comparison of earnings in other industries, and a knowledge of the local labour market.

One should not, at this stage, undervalue the crew or any other costs, by shadow pricing, as one might be tempted to do, for instance, in areas of high unemployment.

1/ 2/ 3/ See Bibliography

At this stage all costs should be those actually to be paid, Imports c.i.f., including duties and local taxes, if these are to be paid. Any existing or projected financial incentives for investment, such as rebates of duty, special tax treatment, etc., should also be allowed for. Exports should be valued c.i.f. or f.o.b. depending upon whether local or foreign prices are the basis of the revenue estimates.

3.1.6 Location

A decision as to the size and type of the vessels usually implies a decision concerning their bases of operation, since profitability is markedly affected by changes in the fishing cycle. Where the project is to expand an existing fleet or marketing complex this may pose no problem, but where alternative ports are available (excluding for the moment the special problems of locating new ports) the investment project may be greatly influenced by the choice of port. Marketing costs too may often be similarly affected.

Given good estimates of prices and costs, fairly sophisticated operational research techniques exist for optimizing the location decision, but where the vessels and gear themselves are at choice, as indeed at this stage is the whole concept of the project, this is likely to be very complex.

Again a partial analysis of the costs and returns of selected types of vessel from alternative ports may be useful, but it should be remembered that all the project costs, marketing, processing, transport, etc., are also likely to be influenced by the location. The decision is likely to be constrained by the existence, or otherwise, of adequate physical facilities, not only for the vessels, but also for the marketing and processing elements, and the choice in the end often resolves itself into changes in the primary costs of the fishing operations versus changes in marketing and distribution costs.

Once again, the objective, or design philosophy, of the project may be recalled to assist in the decision. If the project is primarily one to expand fish catches, or generate more employment in coastal areas, vessel cost considerations may carry more weight, whereas if the project is aimed at expansion of consumption, or the development of new products and markets, marketing and distribution costs may be deemed more important.

Where the locational problem cannot be decided in the light of these fairly general cost considerations, and, clearly, it must be done at an early stage of the formulation process, if the dentification/ pre-feasibility study has not decided the matter, one can only recommend a special, prior, locational study before project formulation proper can begin.

3.1.7 Market analysis

For marketing and processing projects, one now may proceed to the design of the physical facilities. First, consideration should be given to the market analysis of the project in order to establish the quantities and prices of various types of product which may be expected to sell, and their seasonal variations if any. It may be that additional research and analysis, with specific inquiries in target markets, will be advisable especially if the project identification stage was based on rather general considerations. In many cases, this analysis will largely determine, not only the size of the project, but also many of its principal characteristics such as mix of products, types of processing required, and so on. The importance of good market appreciation cannot be overstressed. Consideration must also be given to the market structures and channels. Are existing arrangements adequate for the proposed project, or is it necessary to design, and include in the costs, a new distribution system? Are retail points of sale adequate? Similar questions must be asked.

Given answers to these questions of scale and product types, the technical aspects of the marketing or processing plant may be determined and their capital and operating costs estimated.

3.1.8 Technical design

Almost all but the simplest projects consist of a number of elements, for example, investment in vessels and fish catching operations, market facilities, processing plants, infrastructural services, etc. Before going on to the analysis of the project, it is desirable at this stage to ensure, as far as possible, that the "balance" of the elements is correct. In theory, the net returns from a given total size of project will be maximized when the marginal return to incremental investment in each element is the same. This may be calculated by comparing, by discounted cash flow methods, for each major element in turn, the changes in the rate of return for (small) postulated changes in their size, or capacity, and investment cost, and for some very large and complex projects will be well justified,

providing answers to such crucial questions as:

(a) Is it better to have more, or more sophisticated, processing capacity rather than more investment in a fresh fish distribution syste/ ?

(b) Is it better to have more vessels of existing type or fewer of a larger type?

It is, however, rare that this process can be carried through to a logically satisfactory outcome, with a common rate of return for all elements due to technical constraints, the discontinuous nature of most plant investment and the wide range of economic capacity of low capital cost elements such as market halls. It is however necessary to ensure, at minimum, that the operating capacities of the various elements are matched as well as can be arranged. This means, for instance, that the fleet can land sufficient supplies, at an adequate rate of return, to supply the market with a throughput sufficient to justify the capital costs and to supply the processing plant with sufficient raw material that it operates at an adequate rate of return.

If we take the final consumer price as given, we may say that each element should be dimensioned to give minimum cost per unit output at each stage for a given total throughput.

Probably the best and most common approach in practice is to dimension the elements according to technical considerations and the general size and objective of the project and consider the differences in capacity between them in the light of such considerations as the need for daily and seasonal flexibility, long-term possibilities of expansion, etc., and this method is generally sufficient to produce a well balanced, if not optimal, project.

This brings us however to an important economic point which has often been overlooked with unfortunate results. Even if the total project promises a large and attractive rate of return, it is still necessary to ensure that the individual elements themselves receive a "fair" and adequate return in relation to the risks involved. If the total project is under a single ownership and control, it is possible for one element to subsidize others indefinitely, but where this is not the case, the project will not work. Either the balance of the elements is wrong, or the values of intermediate prices and costs are wrong, and, in practice, would have to change. At its simplest, with given consumer prices, the processing plant or retailer, should make a profit at buying prices which give the vessels a profit, at which crews' earnings are competitive. There is little room for juggling with the first and the last of these. This is the reason why vessels' earnings should be estimated for every project, whether involving direct project investment in vessels or not.

There are some exceptions. In many projects, some elements are included which clearly in themselves are not likely to be profitable, or even revenue earners, such as small slipways, net drying grounds, small cranes, box stores, etc. They are to be justified as necessary components of the revenue earning elements, and should be appropriately integrated with these in the cost analysis, as mentioned on p. 33, 3.6.5.

3.1.9 Summary

These considerations will lead to the definition of a specific project for investment; hopefully one which meets the stated objective, is technically sound and feasible, less effective alternatives having been considered and discarded, and one which has from the economic point of view a reasonably optimal scale and "balance" between its various elements. Is it sufficiently detailed to permit reasonably accurate estimates of its capital and running costs and of its output and revenues. The task remaining for the project team is to consider the worth or feasibility, of this project from various points of view, and to show that it would be a justifiable use of scarce investment resources. This is the purpose of project analysis.

3.2 Project Analysis

3.2.1 Financial analysis

The first part of project analysis consists of demonstrating that, in the given economic environment of prices and costs, including transfer payments such as duties and taxes, the project will produce a surplus of revenues over costs, over a sufficient time span, to justify the project as against all competing uses of scarce funds.

The first step in this process is to set out the Capital Investment Schedule. This will show, item by item, the cost and timing of capital expenditure over the life of the project, including where appropriate, provision for renewals and replacements. It should also show, in the contrary sense, the estimated Residual Value of these assets at the end of the project period. This may be done by ordinary depreciation calculations, but it is more commonly and perhaps better done by estimating second-hand or scrap values of the equipment against the time expired, and by reference to current market values. Where land has been reclaimed, it may be entered in the Residual Value at either cost or current market value, i.e. undepreciated.

3.2.2 Choice of project period and timing

The choice of the project period sometimes poses difficulties. It should certainly be no longer than the life of the principal initial assets of course, but regard should be had to possible developments in technology and the probability of obsolescence before the equipment is actually worn out. As can be seen from the discount tables discussed below, at reasonable rates of interest such as we find in developing countries, the discounted annual values of even high yielding projects are negligible after about twenty five years, and there is little point in continuing the analysis past this stage, as it will make practically no difference to the rate of return. As a general rule, born of experience, for fisheries projects principally involving modern steel ships and/or up to date freezing and other types of processing plants, a project life of fifteen years is about right. For artisanal fisheries development, based on small wooden vessels and rather more highly stressed engines, ten years should be an adequate period, as it should be for marketing projects not involving very substantial fixed investment. For large port and harbour projects, the life of whose major works, often including land reclamation, is clearly upwards of fifty years, a twenty or twenty five year project period will be adequate, and give a sufficient approximation to the rate of return, if adequate care is taken over the assessment of Residual Values. The Project Capital Inputs should include provision for working capital, or funds for operating expenses in advance of receipt of revenues.

In preparing the investment schedule, careful consideration should be given to the timing of the major items of expenditure. Whilst financial provision has to be secured for the whole project before its commencement, it is neither possible nor desirable to spend it all in the first year. Within the bounds of technical necessity the longer a major expense can be deferred, the more the returns can be improved. Capital expenditure on a fleet of ships, for example, should reflect the actual timing of deliveries, and the method of stage payments. Where the fleet is expected to build up over a period of, say, three years, great thought should be given to designing the processing plant so that its capacity may be expanded in step with landings, rather than the once and for all cost being entered in Year 1. This is particularly important with port and harbour works, whose berthing and handling capacity should, wherever possible, be phased. This again is due to the fact that later expenditures are discounted more heavily than earlier ones.

A total expenditure of 10, spread over 3 years, rather than all committed in Year 1, represents a capital saving at 15 percent of interest.

3.2.3 Local and foreign exchange costs

For ease of later calculations, the capital costs in the Investment Schedule should be separated into local and foreign exchange costs, though, of course, these must be shown in the same units. What this unit should be is open to choice. There is a tendency in many developing countries to take exception when important local projects are calculated throughout in, say, U.S. dollars, though this is often most convenient to the analyst, especially where there is a large foreign exchange component. The international financing agencies too tend to work in dollars, or dollar-linked units of account. However it is recommended that most projects should be worked in local currencies, and a prominent note displayed of the rate of exchange adopted.

3.2.4 Project operating costs

Next, the recurrent operating costs of the project must be estimated in detail for each year of the project life. These should be the costs actually to be incurred, including taxes and duties, foreign exchange premiums, etc. As with the Investment Schedule, they should be classified by the major elements of the project, for ease of later calculations, and broken down into local and foreign exchange costs as they affect the project, that is, for example, though fuel oil may entail a foreign exchange cost to the country, the project will buy it locally in local currency and it should be entered as a local cost.

If the project is fully "structured", i.e., details of its financing are known, interest payments on borrowed capital, if paid, should be entered in the costs as a separate item. If financing details are not known, interest on capital should be omitted (see page 20). Since it is not actually a paid-out cost, Depreciation should not be included in the recurrent cost schedule. We should perhaps mention here that we are now solely concerned with the actual project investment. If the project envisages, but does not include, associated investment by other parties, as for instance a processing plant project depending upon an expansion of the fleet by other private investors, this associated or dependent investment and costs are not to be included in the project accounts, though, as we have said (page 24) some assurance that such investment is justified should find a place in the project report.

3.2.5 Project revenues

The summary totals, year by year, of Capital and Recurrent Costs gives the Total Annual Costs of the project. The Revenue Schedule should next be prepared, showing for each major element of the project the expected net income over the project's life, from the final outputs of the project in local and foreign currencies.

Some care is necessary to guard against double-counting in a multi-element project. It is better not to charge, for instance, raw material costs within the project, and to treat all revenues as accruing at the final stage. For any analysis by project elements the breakdown can be done separately.

3.2.6 Net cash flow

The final step is to subtract the total costs from the revenues, and end with a bottom line, the Net Cash Flow of the project, year by year through the project's life, whose values will generally have a negative sign in the first few years, and positive ones thereafter. Down the right-hand margin are shown the total Costs and Revenues of the project over its total life, and the Net Balance.

This very large sheet of paper now embodies all the financial facts and assumptions of the project - as they affect its financial performance. It reflects the technical methods and constraints, the project team's view of its timing and performance, the nature of its costs and revenues, and so on. At this point, it is generally useful to make a condensed summary of the kind shown in Table II. All future calculations of profitability, balance between elements, foreign exchange contributions, etc., should be carried out on the basis of this data sheet, which we will call the Financial Cash Flow Statement.

3.3 Economic Analysis ("Social" Analysis)

The preparation of the Financial Cash Flow Statement just described is the basis for the financial analysis of the project. This may be evaluated, as described in the next section, with respect to the total capital invested, or with appropriate corrections, to ascertain the return to the project authority or private investors concerned, or the return on the foreign exchange required and so on.

It is, however, not entirely a satisfactory basis to judge the worth of the project from the point of view of the society at large, i.e., the "economic" analysis. This is essentially for three reasons.

3.3.1 Transfer payments

Prices and costs most often include elements of taxes or import duties, and sometimes subsidies. While these may properly be regarded as necessary costs or benefits to the project authority, and thus be included in the financial analysis, they are not costs or benefits to the society as a whole, but transfers between sections of that society. In economic analysis we therefore enter costs and benefits net of these transfer payments.

3.3.2 Market imperfections and shadow prices

For a variety of customary or institutional reasons the actual prices paid for project inputs, i.e., the going market rate, may not properly reflect their true "opportunity" cost to the society.

In this case, costs are evaluated at "shadow" prices, i.e., values which more closely reflect the true cost of the input to the society. The estimation of shadow prices requires great caution. It may be said that even with all the imperfections of markets and inadequacies of market prices, they are still, in most circumstances, the best guide available to the "true" value of the inputs. As a general rule, therefore, providing transfer payments have been properly eliminated, the use of shadow pricing in fisheries projects should be limited to the following cases.

Table II

Cash Flows Statement to Project Authority
Based on: Port and Processing Project, Paita, Peru

Unit: U.S.$'000

Year	1	2	3	4	5	6	7	8	9	10	RV	Total
Capital Costs												
Port Works												
Land Fill	100	120	80									
Quays	10	130	180									
Piers	20	80	80									
Design and Utilities, etc.	743	280	70									
Sub Total	873	610	410								900	1 893
Fish Terminal												
Market Hall		206	70								200	276
Ice Plant		900	450					100		100	800	1 550
Sub Total		1 106	520					100		100	1 000	1 626
Freezing Plant		1 690	880					500		300	1 800	3 370
Reduction Plant				680				400		100	700	1 180
Total	873	4 512	2 330	680				1 000		500	5 400	9 895
Annual Recurrent Costs												
Port												
Terminal			160	200	232	232	232	232	232	232		1 752
Freezing Plant			1 760	3 520	4 164	6 808	6 808	6 808	6 808	6 808		43 484
Reduction Plant					275	387	472	472	472	472		2 550
Total Recurrent Costs			1 920	3 720	4 671	7 427	7 512	7 512	7 512	7 512		47 786
Total Costs	873	4 512	4 250	4 400	4 671	7 427	7 512	8 512	7 512	8 012		57 681
Revenues												
Port Charges				23	23	23	23	23	23	23		161
Terminal Charges and Ice			350	415	415	415	415	415	415	415		3 255
Freezing Plant - Sales			2 346	4 692	6 963	9 384	9 384	9 384	9 384	9 384		60 921
Reduction Plant - Sales					405	600	750	750	750	750		4 005
Total Revenues			2 696	5 130	7 806	10 422	10 572	10 572	10 572	10 572		68 342
NET CASH FLOW	-873	-4 512	-1 554	730	3 135	2 995	3 060	2 060	3 060	2 560	5 400	10 661

(a) Foreign exchange

In most developing countries, foreign exchange rates are controlled or administered by the government, frequently supported by physical controls on imports and exports. Most often, the official exchange rates are fixed below the true opportunity value of foreign currencies. With balance of payments problems, and a felt shortage of sufficient foreign funds, it is generally clear that local currencies are overvalued in relation to the main international trading currencies, and a true economic evaluation of a project should take into account this "real" cost of the foreign inputs to the project. The estimation of a shadow price is rather difficult. In many projects, use has been made of the well established "black market" rate, but this is an imperfect guide since it includes allowances for extra risk, and often for illegal operations. Where multiple exchange rates are in use, the weighted average of the effective rates will give a better approximation to the shadow rate, but it is still open to the criticism that all the rates and their average overstate the value in local currency of the marginal dollar earned. Where there are substantial exports of an internationally traded basic commodity, a comparison of local and world market prices may give a measure of the exchange rate to use, after local prices are corrected for any duties and taxes, transport costs, etc.

(b) Labour

In economic analysis, the cost of labour to the project should reflect the social opportunity cost, i.e., the foregone marginal product of labour in alternative uses. It has been argued that in countries of labour surplus, and particularly in regions of high unemployment, the marginal product of unskilled labour is zero. This is, however, almost never the case due to seasonal variations in labour demand in agriculture, and the widespread nature of subsistence fishing with very simple gear. On the other hand, the social cost of skilled or semi-skilled labour, say, diesel engine mechanics or welders, is often greater than the prevailing rate in the fisheries sector. Where the creation of a new or extended fisheries sector requires the movement of population, due allowance should be made for transport and relocation costs, as well as necessary training. It is not possible to provide any simple rule for determining the shadow wage rate. It requires a detailed knowledge of the local labour market situation. The simplest and best approximation is, in areas of high unemployment, to fix the shadow rate of wages at some lower percentage, say, 50 or 75 percent, of the going rate for unskilled labour and enter semi-skilled and skilled labour which has alternative employment opportunities, at the going rate in these alternative employments.

A special problem sometimes arises in processing industries which offer employment to women, who hitherto have not entered paid employment outside the home. The foregone production of such labour in the home or family smallholding is almost impossible to measure and such labour should be charged at 50 percent of their actual wage rate. The use of differential shadow wage rates between regions is often a means of reflecting both reality and the government's regional development priorities.

(c) The shadow price of capital (the social cut-off rate)

In financial analysis, the cost of capital is measured by the rate at which it can be borrowed or invested, due allowance being made for risk.

In most developing countries the capital market and financial institutions are imperfect, and the going multiple rates of interest do not reflect either the existing marginal productivity of capital nor, more importantly for our purpose, the Social Rate of Time Preference of the society or its government. The fact is that neither society nor individuals have a wholly consistent set of preferences. Even if capital markets were perfect, the preferences between present and future consumption as shown by individual spending and saving patterns are not necessarily consistent with individual and collective preferences with respect to the rate of investment and the growth of capital and output. This is particularly so where much of the investment realizes benefits whose value cannot easily be quantified, as for instance in education and social services, or in improved nutrition. It is virtually impossible, at project level, to determine the Social Rate of Time Preference, or the proper cut-off rate for socially and economically desirable projects.

It should be also borne constantly in mind that the true purpose of the economic analysis of projects, particularly relatively small, sectoral ones, is to permit a true comparison and choice between projects spread over all sectors of the economy. This purpose is not fulfilled if each separate project calculates for itself the shadow prices of its major inputs and the Social Cut-off Rate of Capital. For this reason, wherever possible, such prices should be sought from the central planning agency.

(d) Market prices

Where the domestic market for the project output is highly protected by means other than control of the exchange rate and import duties, there is a case for using world market prices, c.i.f., in the valuation of the output to be sold internally. This is based on the reasoning that it is always possible to import the output rather than produce it locally if the true economic cost is shown to be too high. This may often not accord well with the government's longer-term strategy for the development of local resources especially in fisheries and food production, but in any event it enables the true economic cost of such a policy to be evaluated. Table III may help to make the distinction between financial and economic analysis clear.

3.3.3 Indirect and secondary economic effects of the project

We have, so far, discussed the direct costs and benefits of the project either to the project authority or, by corrections for transfer payments and imperfect pricing, to the economy at large.

Many projects, however, generate indirect and secondary benefits and costs which do not accrue to the project, and which are not reflected in the project accounts or in the economic evaluation as we have described it.

(a) Indirect effects

These are costs and benefits deriving from the existence and operations of the project which accrue to other sectors or enterprises. Though indirect, they are not secondary in the sense of being responses to general and pervasive changes in the economic environment induced by the project, or linkages between second and third parties. They are generally known in economic sciences as "external economies and diseconomies", and must be taken into account in assessing the "economic" or welfare aspects of the project. They are alternatively known as "spillover effects" or backward and forward linkages.

A most typical situation in many fisheries projects of an industrial character is their impact upon existing fisheries. Additional substantial fishing effort may diminish the catch per unit effort of existing operators, or very typically, the introduction of a new fishery such as trawling may have adverse effects upon traditional fisheries such as longlining or floating gillnetting. On the other hand, the creation of a modern fisheries sector often has beneficial effects upon the market situation of existing artisanal fishermen, or in their supply of requisites. This is particularly the case in fishery harbour projects where many of the benefits of the project are external to the project authority in the sense of permitting more efficient or larger operations to vessel operators or better handling and quality to processors.

The existence of external benefits and costs is in some degree a function of the definition of the boundaries of the project. If a project is defined widely enough to embrace most sectors of the fishery and its associated activities, e.g., vessel construction or ice provision, many benefits which might otherwise be external become internal even where no direct investment is contemplated.

A more general case of linkages is in the effect of the project upon the direct suppliers of inputs to the project, or its customers through changes in demand and prices. A typical case might be the effect of a live bait or longline tuna fishing project upon the price of small pelagic species used for bait.

Such indirect benefits and costs are clearly part of the social welfare impact of the project, and should be included in the economic evaluation. We may say that where spillovers, i.e., the effects of the project upon sectors or enterprises supplying inputs or receiving outputs directly from the project, or in other sectors directly affected by the project's existence, can be clearly identified, an effort should be made to evaluate the costs and benefits and include them in the net flows of the economic analysis of the project whilst still keeping separate direct and indirect benefits and identifying the beneficiaries (or sufferers).

Such effects are often difficult to identify and very often extremely difficult to quantify, and recourse will frequently have to be made to a narrative description in the section of the report dealing with the national economic effects of the project.

TABLE III

Cash Flow Bases in Project Analysis

Revenues	Expenditure	Net Cash Flow
A. Financial Sales at Market Prices Stocks in Hand Subsidies Received Borrowings Residual Values	Capital and Operating Expenses at Market Values, including Taxes and Duties Social Security Payments Interest and Principal Repayments	Embraces the return, to the project of: (a) Capital Invested (b) The profits of this Investment in the form of Dividends, Cash Reserves and Depreciation and Interest
B. Economic Sales and Stocks at Market or Shadow Prices, less any Subsidies Residual Values Indirect benefits external to the project	Capital and Operating Costs at Market Prices, less Taxes and Duties Labour and Foreign Exchange Costs may beat Shadow prices Indirect Costs external to the project	Embraces the return, to the society as a whole excluding secondary effects of: (a) The total capital invested (b) The returns on the investment in the form of the projects cash balance and earnings paid out, plus taxes and duties, etc., and less subsidies Plus the net external effect of the project on related sectors

(b) Secondary benefits and costs (income and employment multiplier)

Any project which directly or indirectly generates income and employment will have a beneficial effect upon national income and growth, both through its immediate effects, and through the spending and savings patterns of the primary recipients, which generate further growth and employment throughout the rest of the economy. However the identification and evaluation of these secondary multiplier effects pose serious practical and conceptual problems, and economists are by no means agreed that they can, or should, be included in the economic appraisal of projects.

Although the size of the income multiplier is easily and formally defined as the inverse of the (marginal) rate of savings, i.e., $\frac{1}{1 - \text{Marginal Propensity to Consume}}$, the secondary benefits are widespread, and of course, apply equally to all projects; that is to say the selection of a project on its direct and primary indirect benefits would not be different from its ranking including the effect of the multiplier, except perhaps in cases of marked regional differences in the Marginal Propensity to Consume.

At the project level, therefore, particularly in view of the moderate size of most fisheries projects in relation to the economy, it is not recommended that multiplier effects be taken into account.

(c) Intangible benefits

Almost all projects have attractions additional to those which can be quantified in the economic analysis such as better income distribution, better regional balance, strategic objectives, etc. These are most frequently of a highly subjective nature and their evaluation is a matter of judgement in the final decision-taking process. As we have said, the final investment decision rests upon many factors beyond the ability of the project analyst to identify and quantify.

3.4 The National Economic Effect of the Project

In the discussion on the economic analysis of the project, we have developed an assessment of the social worth of the project, judged by its use of real resources at prices more in accordance with their true scarcity values, and taking into account the project's indirect impact upon associated sectors. As we have said, this is necessarily a restricted and partial view, not taking into account the national importance and relevance of the project. The government, investors and financing agencies require an indication of the relevance of the project to general national economic objectives.

These are in general, given the size of most fisheries projects, difficult to define in a quantitative way. Except for very large fisheries projects it is not recommended that great effort be made to evaluate the national effect of the project in a precise and quantitative way since to do so most frequently implies a great number of assumptions and is therefore often highly speculative.

The principal matters to be discussed are:

1. Contribution to Gross National Product

This is measured by the total Value added by the project, that is the sum of the direct and indirect benefits less the cost of external inputs to the project plus indirect costs in other sectors, times the national Income Multiplier, if known. The project's internal inputs are excluded from the calculation being already included in the costs of the project and the value added so calculated comprises the return to these inputs.

2. Contribution to total employment

This should include both direct and indirect employment effect of the project. There exists the concept of Employment Multiplier, similar and related to the Income Multiplier, but it is difficult to estimate and its use is not recommended. Fisheries projects should particularly discriminate between the levels of skill involved. There is clearly a considerable net benefit in generating employment for unskilled labour in conditions of underemployment, whereas the same may not be said of the intensified use of relatively scarce industrial skills such as electricians or welders for instance.

3. Contribution to foreign exchange balance

Most fisheries projects will involve both direct foreign exchange costs in the form of vessels and engines, plant, etc., and ongoing local costs for imports, such as fuel, synthetic yarns, etc. In addition there may be similar costs for sectors indirectly affected by the project. The foreign exchange earnings of the project will depend upon the extent to which its output is exported, plus savings of foreign exchange from import substitution. Estimates of these costs and revenues may fairly readily be made and the foreign exchange balance calculated. Conceptually the effect of the Income Multiplier and the marginal propensity to import should be taken into account, but this is not recommended for most fisheries projects. The servicing of foreign loans, repatriation of capital and profits and expatriate crew earnings should be taken into account where appropriate.

From this balance, one may calculate the project's Internal Foreign Exchange Rate (Gittinger), i.e., the domestic cost of a unit value of output in foreign exchange, for comparison with the shadow foreign exchange rate and thus determine the real costs of import substitution.

4. Contribution to regional development

Most fisheries projects take place along coastlines, often in areas of relatively low economic development. Many governments look to the fisheries sector as a principal tool in the development of economically backward or resource-poor regions. Where this is the case, the impact of the project on regional employment and incomes should be shown, including the indirect effects of the project. As we have mentioned, regional priorities may be reflected in the use of differential shadow wage rates.

5. Contribution to nutrition

Where a fisheries project is primarily intended to supply the internal market, its impact on the nutritional status of the country of region should be shown, not neglecting the special significance of animal proteins in the diet.

Where improved nutrition from national resources is a declared government objective, it may often be helpful to compare relative costs of protein and calories, etc., from alternative agricultural sources.

Equally, where the fisheries production can be exported, the real foreign exchange cost, i.e., earnings of foreign exchange foregone, of domestic supplies should be shown.

6. Contribution to income distribution

Given the marked income disparities in many developing countries, and the tendency for these to increase rather than diminish, many governments prefer to promote public sector projects which tend to improve lower incomes rather than, say, rewards to managerial and entrepreneurial interests. The distribution of direct and indirect incomes should be analysed and the beneficiaries identified where possible.

7. Other benefits

We have proposed that, where they can be identified and measured, the indirect, external benefits of the project should be incorporated in the economic analysis of the project and in the calculation of the Economic Rate of Return neglecting for practical and conceptual reasons the inclusion of secondary effects.

In many, if not most cases, the evaluation of indirect benefits will pose problems if only for lack of data. Where it has not proved possible to incorporate such indirect benefits explicitly in the economic analysis, special treatment and discussion may be given to important possibilities, spillovers, forward and backward linkages opened up by the project, such as opportunities in ship-building and repairing, gear manufacture, processing industries, equipment supplies, etc.

3.5 Pre-Project Costs

In the case of substantial production or infrastructural projects there are often large pre-project costs in investigations and design studies to be incurred before the irreversible investment decision. Sometimes these can be written off against other funds, such as planning or departmental accounts, as most often are the costs of pre-feasibility and identification studies.

Quite often the project authority is expected to reimburse these costs when the project is in successful operation and, since these are necessary costs of the project, this is quite proper.

We should be clear however that the costs have been incurred, irrevocably, before the investment decision and are known as "sunk costs". At the time of the investment decision they have no bearing or influence upon the future income-generating capacity of the project, or its ranking among alternatives, and should be disregarded in estimating the future costs of the project from an investment appraisal point of view, even though they may be found in the future liabilities of the project authority.

Where however design and investigation costs are envisaged at the time of project formulation and subsequent to the investment decision, they properly form part of the future costs of the project and should be included in order to preserve a fair comparison with alternative projects whose design and investigation costs may be different.

Where they are necessary delays between the taking of the decision and the commencement of the construction phase of the project, it is often desired to start the project period from the date of construction and the major expenditure of funds. In such a case the early design expenses may be compounded forward to Year 1 of the project period and included in the Capital expenses. The appropriate compounding rate is the going rate of interest on borrowings.

3.6 Financing and Management Aspects of the Project

Having regard to the way in which many projects are initially conceived, particularly those arising out of the work of the FAO and UNDP field programmes, where great initial uncertainty exists as to the ultimate project sponsors and management and the means of financing available, we have been at pains in this Manual to exclude consideration of the effects of the specific financing and management characteristics of the project; i.e., we have largely referred to "pure" as opposed to "structured" projects. In the financial analysis we have described the computation of the Internal Rate of Return as the return to the total capital employed in the project regardless of its origin. This is often the limit of responsibility for technical experts in the field, and the appropriate managerial and financing decisions will be taken by the government at the same time as the decision to proceed with the project.

Certainly these questions have to be settled before a loan application is made and before the final appraisal stage. Where the details of financial and managerial structure are known, the project report should include the following analyses.

3.6.1 Gearing

In the light of the risks to which the project is exposed, as shown by the sensitivity analysis, the timing of the cash flows and the asset structure of the project, consideration should be given to relative proportions of equity and loan capital appropriate to the project.

3.6.2 Sources and uses of funds

This will set out the capital requirements of the project in local and foreign currencies, classified by various types of investment, e.g., vessels, plant, infrastructure including training expenses, etc., initial and pre-project expenses, working capital and so on. It will similarly display the sources of the necessary funds, e.g., equity shares, loans, government contributions, credits from suppliers, and where appropriate, multilateral or bilateral aid inputs to the project.

3.6.3 Rate of return on the equity

Where the proportion of equity shares is known, the Internal Rate of Return to the equity shares may be calculated by the methods previously described, allowing for interest payments on loan capital. If financing is to be sought on the capital market, the sensitivity of this rate to various changes in basic parameters will need to be shown.

3.6.4 Financial timing and cumulative cash balance

The timing of various capital outflows and revenues should be carefully estimated, in both local and foreign currencies, and an optimal plan devised for the timing of loans. From this may be calculated the Net Cash Balance of the project for each year of its life, and thus its ability to

finance interest payments, and provide for future expansion. These considerations will also indicate the desirability of grace periods on loans, or future injections of capital. The annual ratio of liquid assets to current liabilities should be calculated to indicate periods at which the project may be at risk of cash shortage, and particularly vulnerable to adverse changes in the project's parameters.

3.6.5 Profitability of project elements

Profit and loss statements should be calculated for each separate major element of a complex project to ensure that each element is independently financially viable. This is particularly the case where capital funds subscribed from a variety of sources are earmarked for particular elements being, in effect, separate sub-projects, as may be the case for instance where a foreign partner is financing a shore processing plant, and a local partner financing expansion of the catching operation. This may involve the allocation of joint and overhead cost elements as mentioned earlier (page 24). There are some sophisticated techniques for the allocation of joint costs (see Gittinger for a discussion) but for most fishery projects, with the exception of harbour developments, it will suffice if the costs remaining after allocation of directly attributable costs to revenue-earning elements are allocated proportionately to revenues.

3.6.6 Profitability of associated activities

Profit and loss statements should be shown for specific activities on which the project depends, even where these are not part of the investment project itself. This is particularly the case where a project depends upon the catches of individual vessel operators, or on a number of separate retail outlets. It is necessary to ensure that conditions exist for the continuing operation of such associated activities.

3.6.7 Management responsibility and managerial structure

The project authority should be clearly designated, and its functions and responsibilities defined. Where the project authority is subordinate to a government department, the nature of the relationship should be made clear.

Where the project authority is an independent entity, the nature, composition and functions of the management board should be described and a description with organigrams of the management functions and operational responsibilities given.

If the project management is an already existing enterprise, the report can include a description of its current organization, history, and financial status.

In general, as much detail should be given as is available. If nothing has yet been decided about the financing and management of the project, the project report will have to limit itself to a discussion of appropriate gearing, the Cumulative Cash Balance, and the overall profitability of the project and its principal elements. If, on the other hand, the details of financing and management are known the report may include as much detail as is required, for instance, by the international financing agencies for loan applications.

The purpose of this section is to show that, given the characteristics of the project, an optimal financial plan can be prepared, that the project will be adequately profitable and attractive to different sources of finance, that it does not rest on implausible assumptions concerning the prices of inputs and outputs, and that the project is manageable with currently available skills and techniques.

3.7 Conclusions and Recommendations of the Project Report

The project report should conclude with a succinct appreciation of the project described, recommending it for adoption, and stressing its principal advantages, matters which will have been covered in more detail in the body of the report. The recommendations should include reference to outstanding issues, such as the need for further studies and preparation, decisions required for the creation of the project authority or other institutions, the need for additional inputs such as multi-lateral or bilateral assistance, preparation of tendering specifications, resolution of outstanding policy matters, such as the respective roles of government and private investors, etc.

Where substantial foreign currency borrowings are envisaged, this section may also discuss sources of such financing and propose initial inquiries of appropriate lenders.

3.8 Project Appraisal (Project Review)

The project is now fully prepared and detailed, the financial and economic evaluations have been made, and various related matters discussed. All necessary information to the taking of the investment decision is displayed. Before this is done, however, the final step is to carefully review the information, assumptions and calculations of the project proposal. This stage is known as project appraisal, and is usually undertaken independently by a team of experts representing either the government, project sponsor, or most often, by the financing agency concerned.

The objects of the appraisal are:

i. To evaluate the reliability and consistency of the estimates and basic data used in the project formulation.

ii. To examine the basic assumptions of the project.

iii. To check the calculations used.

iv. Generally, to ensure that the project is soundly conceived, efficient and manageable.

The extent of the work involved in project appraisal is thus closely related to the thoroughness and detail of the project preparation. Where there are gaps or uncertainties in the information, the appraisal team will make independent inquiries and estimates, and, generally, revise the project. At its conclusion, the appraisal process should give clear answers to the following main questions:

(a) Does the project meet priority needs?

(b) Is the project efficient in meeting these needs?

(c) Is the project proposal suitable for financing and execution?

The appraisal review is therefore carried out under the following main headings:

1. Technical Review

2. Commercial Review

3. Financial Review

4. Economic Review

5. Organization and Management Review

It is not proposed here to discuss in detail the work involved in the appraisal of the project. The questions to be asked and the techniques involved are those discussed earlier and, of course, all the matters involved in the appraisal will have, or should have, been anticipated and discussed in the project proposal itself. Reference should be made to the excellent check-list of appraisal issues contained in Engstrom (1974), "The Preparation of Fishery Investment Projects" (Appendix III).

Often the project preparation team will give required assistance in the appraisal process, but due to administrative delays, etc., they often may not be available. For this reason, we have suggested that the main body of the project report contain only results and discussion and detailed analyses and calculations be contained in appendixes or a separate section of the project report.

CHAPTER IV - Measures of Worth and Other Indicators

4.1 Simple Indicators

There is a variety of methods and indicators in general use to measure and compare the financial and economic performance of a project with respect to its owners and sponsors and to the society at large. Some are relatively simple to calculate, but have serious shortcomings. They are however quite useful at times as preliminary indications of the value of a project, often enabling a decision to be taken on whether to proceed to more sophisticated analysis or not.

The essential problem with evaluating projects is that Costs and Revenues occur over time, and no method which does not allow for this fact can be really satisfactory. For this reason we may say that all projects should be evaluated by discounting methods described below.

The object of this analysis is to compare the Capital and Recurrent Costs of the project with its revenues, and in the case of economic analysis other non-revenue benefits, and to prepare, in a standard way, an indicator either of the profitability of the project which may be judged in relation to the costs of capital or to rank projects in order of their attractiveness.

Before considering the accepted discounting methods, we may briefly describe the simple indicators.

4.1.1 Simple rate of return

This measure compares the capital invested with the net returns, after depreciation, of the project at some year in its life where normal operation has been attained, i.e., after the planned output has been reached. In a sense, it gives the accounting profit, as reflected in Trading Accounts, in a normal year. A variant of this method uses the average capital employed and the average of the net returns over the project period. Whilst the measure is often satisfactory for ranking purposes between projects of similar time patterns of costs and revenues, its limitations are obvious. It makes no allowance for the incidence and timing of capital outlays and revenues, and so makes no discrimination between near and distant net earnings. It almost always underestimates the yield as calculated by discounting methods, depending upon the rate of growth of earnings, and tends to discriminate against short-term projects, since long-term future earnings have just as much weight as more immediate benefits. Where the capital is averaged over the life of the project being, say, half of the initial capital investment, the error tends to be in the opposite sense and thus overestimates the attractiveness of short-term projects.

It is worth noting however that for projects where the capital expenditure takes place all in Year 1, and which have Constant net earnings the Simple Rate of Return equals the Discounted Internal Rate of Return.

We may say that for simple projects of this type, or for comparison between alternatives with rather similar time profiles of expenditure and earnings, the simple Rate of Return may be used because of its ease of calculation, as a preliminary indication of particular use to the analyst at the identification stage. It should however not find a place in any full project formulation and analysis.

4.1.2 Capital/output ratio

This is essentially the same measure as the simple Rate of Return, the Capital investment being divided by the net earnings, rather than the reverse, and of course, suffers from the same shortcomings. Though widely used in macro-economic planning studies, its use in project analysis should be confined to the analytical assistance at the identification stage.

4.1.3 Payback

This indicator measures the number of years required for the project to recover, from net annual revenues, the capital invested in the project. Strictly speaking therefore it does not measure the profitability or attractiveness of the project, since it takes no account of revenues arising after the capital recovery period, nor of the time pattern of revenues. The following instance makes this clear.

	Capital Cost	Annual Net Cash Flows					
		1	2	3	4	5	6
Project A	100	25	25	25	25	25	25
Project B	100	40	40	10	10	25	25

Both projects have the same capital cost, and the same payback period, four years, but Project B is clearly preferable since 80 percent of the cost is recovered after two years, whereas Project A has recouped only 50 percent of its cost.

Additionally, there are time costs of employing capital in the sense of interest foregone. No project can be said to have broken even if, after a period of years, it has recovered its initial capital without having earned something extra for the use of such capital.

It is considered therefore that the payback period, providing neither a measure of the return on capital investment, nor an accurate ranking of alternative projects, is not an effective indicator of worth. We should note however that, like the simple Rate of Return and the Capital Output Ration, the reciprocal of the payback is a close approximation to the discounted yield (Internal Rate of Return) for projects where the investment is concentrated in a short initial period, and the net revenues are fairly constant, over a period of ten to twenty years. If these conditions are approximately met, the payback method may be useful as an initial screening device in the identification stage.

However, it is quite widely used in business, and many investment decisions are based upon it, and it is worth inquiring why. In the end, the investment decision is not entirely a rational and logical process, requiring only the selection of the project with the highest promised return. Risk and uncertainty have to be taken into account, and this is largely a subjective process, and the longer the period, the greater the risk. In these circumstances, a knowledge of the time span that the original investment is at risk will be a significant factor in the decision, even though it has to be supplemented with other measures of project worth. The method is widely used by firms in potentially risky situations, particularly in cases of investment overseas where political uncertainties tend to be large, where technological progress makes the risk of obsolescence rather large, or where other competitors' reactions, say to the introduction of a new product, will much reduce the early profitability of a project.

It clearly falls into the category of risk analysis, discussed later, rather than as a measure of project worth, but provided its limitations are understood, it is a useful piece of information to appear in a project formulation report, particularly if modified as suggested in the next section.

Having regard to the high risk nature of fisheries projects, it is felt to be particularly appropriate to those situations where the future of the resource is in some doubt, or for instance, in a relatively new international fishery where the size and speed of foreign intervention is hard to forecast. In such a situation it is of great assistance to know whether, on present yields per vessel, the project will recover its capital quickly before competitors can appear in force or not.

4.2 The Main Discounting Techniques

There are two basic discounting techniques with which we are concerned, plus a third of interest and occasional value. The essential difference between them is, in the one case, we know or assume the Rate of Interest to be used and thus calculate the Net Present Value (NPV) of the project. In the other, making no assumption about the rate of interest, we calculate the Internal Rate of Return (IRR) of the project, this being defined as that rate at which the stream of future costs and earnings has a zero net value. Thus a project which has an NPV of zero at 16 percent interest rate has an IRR of 16 percent.

In Table VII we set forth the basic facts about a relatively simple 10-year project, the capital costs, the annual operating costs and the revenues. Column 4 shows the Net Annual Cash Flow. In Year 10, we include the Residual Value of the capital assets of the project.

In practice, there are substantial difficulties in choosing an appropriate Rate of Discount. It should in theory be the rate obtainable from the most profitable alternative use of the funds, but this is most often extremely difficult to assess. In practice it is often set at the rate at which the project can borrow the funds, but this has the effect of embracing in the analysis the special problems and features of the proposed financing of the project, rather than considering it on its own

internal merits. Where, as is most common, the method is used to estimate the "economic" as opposed to the "financial" merits of the project, the appropriate rate is the Social Rate of Time Preference, but whilst this is a simple concept, it is almost impossible to quantify. It may be the case that a national planning agency has established such a figure which all development projects should attain, but if not, it is very difficult for a sectoral analyst to determine.

In the absence of any better guide, and assuming that most projects of the type with which we are concerned, i.e., basic fisheries development projects, will be eligible for financing by the international lending agencies, we may suggest that the appropriate discount rate is the rate of interest charged on normal loans by the World Bank - presently 8 percent including the Bank's special commission.

We should mention here that by convention all costs and benefits are discounted, at year end, for the first and subsequent years. This is clearly theoretically incorrect since the expenditures and revenues are generally spread over the year in question, but no significant error is introduced by this convention and it is much too difficult and time-consuming to attempt to allow for the time pattern of cash flows within the year.

As we have observed, the essential problem in estimating the comparative worth of projects is that the costs and revenues are distributed unevenly over time, and the technique used to overcome this problem is known as discounting.

4.2.1 The time value of money and compound interest

It is almost invariably the case that to borrow money one has to pay, in addition to the repayment of the original sum, an additional amount, interest, for the use of the money during a given period. This is usually specified as a certain percentage of the capital loaned per time period, normally one year. Economists have advanced various reasons to account for this fact. Here it is sufficient to say that generally human nature seems to rate present pleasures and expenditures more highly than ones deferred to the future, and that by lending money, the lender has to defer productive expenditure, for which he expects to be recompensed by the borrower, who will, in most cases, be using the money for productive expenditures himself.

If the loan is repaid in one year or period, the borrower repays the original sum plus r percent interest. If however the loan runs for two years he has to pay the original loan plus r percent interest for the first year, plus r percent interest on the amount outstanding in year two, that is the original sum plus r percent. He has to pay interest on the interest. It will be realized therefore that the sum owed to the lender increases at an accelerating rate the longer the loan is outstanding. At any period end, the total sum outstanding is simply calculated from the formula

$$S = P\,(1+r)^n$$

Where S is the sum outstanding; P is the Principal or Original loan; r is the percentage rate of interest; and n is the number of years or period for which the loan is outstanding. For example, the future worth of a loan of U.S.$ 100 at a Rate of Interest of 10 percent after five years is

$$S = 100\,(1{\cdot}1)^5 = 161$$

We see therefore that, given the rate of interest, there is a fixed relation between the present value of a sum of money, and its value at any future time. In the case of project analysis, we are more interested in the present values of future sums of the earnings of the project. The above equation is easily transposed to

$$P = \frac{S}{(1+r)^n} = S\,(1+r)^{-n}$$

and the Present Value of the original Loan is therefore

$$161\,(1{\cdot}1)^{-5} = 100$$

This simple relationship is the basis of the technique of discounting, as opposed to compounding, which enables us to compare the values of future streams of expenditure and revenues in a correct and measurable way.

It is, of course, not necessary to resort to the formula every time, since pre-calculated tables are available. Best known among these are "Compounding and Discounting Tables for Project Analysis",

published by the Economic Development Institute of the World Bank, though many others are available. The writer normally uses those found in Merrett and Sykes, "The Finance and Analysis of Capital Projects", a specimen of which is reproduced in Appendix IV.

For the types of project with which we are concerned, having regard to the nature of the underlying data, tables to three decimal places are quite adequate. The tables should contain atleast the following information:

1. The Present Value of 1, for up to 50 years, at rates of interest up to 50 percent

2. The Present Value of 1 per annum for the same period and interest rates

3. The Cumulative Value of 1 per annum for the same period and interest rates

Where earnings or expenditures are constant for a period of years, Tables 2 above enable the calculation to be made directly without the need for subsequent addition. The figures given in the body of the tables we shall call "discount factors" or DF, though they are also known as Present Worth Factor.

Considering our previous example, we find from the Table 1 that the Discount Factor for 10 percent Interest over 5 years equals 0:621. The present value of 161 five years hence at 10 percent equals

161 x 0:621 = 99•99 (the small error is due to rounding)

It is worth, at this point, carefully scrutinizing the discount tables to see how, at normal rates of interest of the order of 15 to 20 percent, future values are heavily discounted. For instance the Present Value of a sum due six years hence is worth only one third of its future value at 20 percent, and after ten years worth only 16 percent. It is for this reason that the time profile of net earnings assumes such importance in project evaluation, and also why, for most projects, there is little point in taking the project period to more than 20 or 25 years, as net earnings past this period are negligible in relation to current decisions.

4.2.1 (a) Net present value

For the project described in Table II, the NPV at 7 percent Discount Rate is 7579, as shown in Table IV. We should be clear what this signifies. The sum represents the value, at present time, of the future, as yet unrealized, benefits of the project, less their cost. It represents, in a sense, the maximum value of the project idea, should the project sponsors have a monopoly of it, and wish to sell it to another investor. As such it gives no guide as to the actual return on the initial investment, though it is generally satisfactory for ranking purposes between alternatives.

Table IV

Net Present Value Calculation

Year	Net Cash Flow	Discount Factor 75% .	Discounted Cash Flow
1	- 873	.934	- 815
2	-4 512	.873	-3 939
3	-1 554	.816	-1 268
4	730	.763	557
5	3 135	.713	2 235
6	2 995	.666	1 995
7	3 060	.623	1 906
8	2 060	.582	1 199
9	3 060	.544	1 665
10 a/	7 960	.508	4 044
			7 579

= NPV at 7 percent

a/ Including Residual Value 5 400

The ranking of projects by NPV can be quite different from that resulting from the IRR method where projects vary greatly in size, capital intensity and project life. The principal use of NPV is to estimate the worth of incremental investment in the presence of risk. For instance, note the following example of two mutually exclusive projects, i.e., where both are attractive, but only one can be chosen.

	Capital Cost	Annual Cash Flow	Life	NPV at 7%	IRR
Project A	500	100	10 years	451	20%
Project B	695	130	10 years	563	18%
Project B-A	195	30	10 years	28	11%

Note that the ranking by NPV is different from that given by the IRR method; the Net Present Value of the benefits of the project are greater for Project B, essentially because it is a larger project, and is the project which should be chosen if capital is freely available and all the best projects can be undertaken. However, in a capital rationing situation where all desirable projects cannot be undertaken, Project A represents a better use of scarce capital. This is essentially to say that Project A should be chosen, and the incremental investment required for Project B, 195, used for some other project promising a better rate of return than the given 11 percent.

4.2.1 (b) Benefit cost ratio

Another principal use of the NPV technique in project analysis is to estimate the Benefit/Cost Ratio. This is defined as the ratio of the Present Worth of Benefits, divided by the Present Worth of Costs, including working capital. Some care is necessary in the definition of costs for this purpose. Whilst it offers some computational simplicity to use the Net Cash Flow as shown on the bottom line of Table II, such a convention, including as it does the production costs of the project, tends to discriminate against projects with high returns and large production expenses. The normal and accepted convention is to define costs as capital investment costs plus either operating and maintenance costs, or alternatively, the sum of working capital required.

Table V

Benefit/Cost Ratio

Year	Capital Costs	Maintenance and Operation Costs	Gross Costs	Gross Benefits	Discount Factor 7%	Discounted Costs	Discounted Benefits
1	873		873		.934	815	
2	4 512		4 512		.873	3 939	
3	2 330	860	3 190	2 696	.816	2 603	2 200
4	680	860	1 540	5 130	.763	1 175	3 914
5		980	980	7 806	.713	699	5 565
6		1 100	1 100	10 422	.666	733	6 941
7		1 100	1 100	10 572	.623	685	6 586
8	1 000	1 100	2 100	10 572	.582	1 222	6 153
9		1 100	1 100	10 572	.544	598	5 751
10a/	500	1 100	1 600	15 972	.508	8 114	8 114
						20 583	45 224

a/ Including Residual Value 5 400

Benefit/Cost Ratio at 7 percent = $\frac{45\ 224}{20\ 583}$ = 2.2

In Table V is shown a Financial Benefit/Cost Calculation for our earlier described project. The significance of the Benefit/Cost ratio is that where it is greater than unity, the project promises returns greater than the assumed, or minimum, rate of interest and is therefore acceptable. It has however been criticized as a criterion of ranking since it discriminates against high cost/high return projects whose total net benefits may well be greater than those with a higher Benefit/Cost ratio. It should be noted that the choice of discount rate has a marked effect upon the absolute value of the ratio, a high discount rate reducing the value of the ratio and vice versa. Where the Benefit/Cost ratio is less than unity, it indicates that the project cannot achieve the target or minimum interest rate.

The Benefit/Cost is not normally used as a measure of financial analysis but more commonly in evaluating Social or Economic Worth.

4.2.1 (c) Discounted capital recovery period or payback

As mentioned earlier, Capital Recovery Period or Payback is better seen as a measure of the risk of the project not running to the end of its planned life. It makes no allowance for earnings after the payback period, and thus is certainly not a measure of profitability. We mentioned in the preceding section that, particularly, simple recovery of the initial capital invested cannot be regarded in any real sense as a break-even point, since it makes no allowance for the foregone interest on the capital invested. We now however have in discounting methods a way of taking this latter factor into account.

Consider a simple project where U.S.$ 500 is invested in the first year, and the benefits are from and including Year 1, U.S.$ 100 per annum. The simple payback period is therefore 5 years. At this point, initial capital would be recovered, but nothing in respect of interest foregone, or the cost of borrowing the original cash. If we assume that this latter Rate of Interest is 10 percent, we can calculate the break-even year to cover this extra cost as shown in Table VI.

This is to say that the project will be in the same financial position should it fold up after 6.4 years as it would have been had the money been invested at 10 percent. The payback period for such a project would be at 15 percent interest 7.6 years, and at 20 percent interest 9.8 years.

Table VI

Year	Capital Cost	Earnings	Discount Factor 10%	NPV	Cumulative Total
1	500	100	.909	90.9	90.9
2		100	.826	82.6	173.5
3		100	.751	75.1	248.6
4		100	.683	68.3	316.9
5		100	.621	62.1	379.0
6		100	.564	56.4	435.4
7		100	.513	51.3	486.7
8		100	.406	40.6	528.3
9		100	.424	42.4	570.7

Discounted Capital Cost = 454.5

Payback Period = 6.4 Years

We see, therefore, that the CRP or Payback period is significantly affected, as are other Present Value methods by the choice of Interest Rate.

For an existing single firm or enterprise with a good knowledge of its financial position and standing, the real cost of capital to the firm may be estimated fairly closely and realistically, but in conditions of new projects in countries with less developed capital markets, it is most often very difficult to assess. The rate at which the project capital can be borrowed, say the World Bank lending rate of 7 percent, is of some relevance, since the method implies that the project will recover its

capital, and be able to pay the Bank interest at the end of the payback period. But the project sponsors have higher ambitions than this and wish to see the project generating additional wealth. It is therefore proper to set a rate of interest which the project sponsors regard as the minimum reasonable rate of return on the project, and the payback period then measures how long the project must run to achieve this, assuming of course that the project can achieve some higher rate if it runs its full life.

Probably the best use of this method is in the part of the project report concerned with risk, where a small table will set out the three or four payback periods necessary to achieve selected rates of return which the project sponsors, investors and financing institutions may relate to their subjective assessments of the risks of the project not fulfilling its planned life due to political or economic circumstances.[1/]

4.2.1 (d) Annual capital charge and the sinking fund rate of return

For projects which are largely financed by borrowing and which have a fairly constant pattern of returns as is often the case, for instance, with large fishing harbour projects, it is possible to calculate a rate of return by a relatively simple method known as the Sinking Fund Rate of Return. If we assume that the capital sum borrowed is not to be repaid until the end of the project, then the annual cost of the capital employed is the sum of two elements.

(a) The interest on the money borrowed, and

(b) an annual sum which, if invested at this rate, will be just sufficient to pay off the loan, i.e., equal the initial capital at the end of the project period.

These two elements together are known as the Annual Capital Charge which may be compared with the constant Annual Returns of the project. Since the interest on the annual sum invested in a sinking fund accrues at compound interest, we know that the total of these payments will be less than the original sum borrowed.

The annual interest on the borrowed capital is simple to calculate, being the original sum times the rate of interest. We calculate the sinking fund provision from the Discount Tables - the Cumulative Factor for 1 per annum - dividing this into the original sum to be repaid, thus giving the annual sum to be invested in the sinking fund. If we take a simple 5-year project as an example:

Year	1	2	3	4	5
Net Cash Flow	-1 000	330	330	330	330

The Annual Capital Charge is between years 2 and 5 inclusive:

(a)	Interest at 7 percent	70
(b)	Sinking Fund Depreciation $\frac{1\,000}{.507}$	174
	Total Annual Capital Charge	244
	Surplus	86
	Sinking Fund Rate of Return	8.6 percent
	Internal Rate of Return	12.0 percent

If the Net Cash Flows exceed the Annual Capital Charge, the project is acceptable, though judgement is necessary to gauge whether the annual excess of benefits is sufficient to cover the risks of the project.

The annual "surplus", as a percentage of the Capital sum invested, is the Sinking Fund Rate of Return. It will be identical with the Internal Rate of Return only where the Interest on the sinking fund is also equal to the IRR. If the sinking fund interest rate is higher than the IRR, the Sinking Fund Return will be higher than the Internal Rate of Return and vice versa. Since the project's borrowing rate will, in most cases, be below the IRR, we may state that the Sinking Fund Rate of Return generally understates the Yield or IRR of the project, though both methods will accept or reject the same sets of projects.

1/ For a fuller treatment, including equity, loan and tax considerations of the payback method, see Merrett and Sykes

The method is not recommended for general use in fisheries projects, but where the conditions of large loan capital and fairly constant returns are met, it often provides, because of its simplicity of calculation, a useful first approximation. Projects which fail to show a surplus sufficient to cover the risks involved may be rejected without further detailed calculations.

4.2.1 (e) The internal rate of return

The methods so far described, whilst they have found much application in business and financial analysis, all suffer from a common problem, that of choosing the rate of discount to be employed. Even for a single, existing enterprise, the true marginal cost of capital and how to obtain it presents problems. For a new project, possibly in a new industrial sector, with great uncertainty as to the actual financial structure of the project, it is difficult to assess, and for social or economic analysis, using shadow prices, the Social Rate of Time Preference or Discount, whilst a valid theoretical concept, is almost impossible to calculate with any certainty. This is to say that for all these methods we need an acceptable estimate of the opportunity cost of capital and we have said that in the absence of better estimates we may, in the interests of standardization, and having regard to the type of development projects with which we are primarily concerned, use the World Bank's lending rate.

The Benefit/Cost ratio does not provide a unique and satisfactory ranking of projects, judged by their income-generating capacities, since it discriminates against projects with high returns and operating costs. Net Present Value does not provide a unique ranking of alternative competing projects, since a smaller, highly profitable project may have a lower NPV than a large project of lesser profitability.

These and other more detailed criticisms have been made in the literature, and some sophisticated methods proposed for meeting them.

A measure which avoids some of these difficulties is the Internal Rate of Return. This is the discount rate of interest at which the discounted Costs and Benefits of the project are equal, and the Net Present Value is zero. This measures the earning power of the project, and may be compared with the cost of capital. As such this avoids the necessity of "choosing" a discount rate, and the method has gained wide acceptance by private firms, and is the approved method for the appraisal of applications for loan from international financing institutions, such as the World Bank. It is therefore recommended as the basic technique of appraisal for FAO and other fisheries projects.

The Internal Rate of Return is calculated from the Net Cash Flow of the project, expenses being regarded as negative items and benefits as positive. There is some unique Rate of Interest at which the algebraic sum of the discounted values is zero, and this is the Internal Rate of Return. To find the appropriate rate of interest is rather a trial and error process, but experience brings the ability to make a reasonably close first approximation and we give below a method for calculating a first approximation. If we calculate for a rate of interest at which the residual sum is positive, the true rate is higher, since the series has to be more heavily discounted, and we can calculate again for a higher rate. If the sum is now negative, the true IRR can be found by interpolation. It is necessary to say that since the relationship between the Rate of Interest and the Discount factors given in the tables is not linear, but curvilinear, there is an interpolation error, but this will be negligible, if the two trial rates of interest are not more than 5 percent apart. An example of such a calculation is given in Table VII based upon our earlier example of the fishing port complex in Peru.

In computing the Net Cash Flow, it is not necessary to make any deduction for Depreciation in the costs, since this is implicitly allowed for in the difference between initial capital costs and the Residual Value, which is added to the Benefits in the final year of the project period. The return of the capital used up in the project is also provided by the methods under discussion. A project with an NPV and IRR of exactly zero returns to the investors exactly their initial investment, i.e., the costs, including depreciation, are met but there is no additional benefit, and the returns from a positive NPV or IRR are net of the capital recovery factor, i.e., depreciation.

Nor is it necessary for a "pure" unstructured project where we are attempting to measure the rate of return on the assets employed, regardless of their source, to make any allowance for interest. If we are however assessing the project from the point of view of the project authority, and interest on loan capital is actually paid, this should be shown as a cost. There will, of course, be an offsetting reduction in the project authority's own initial capital paid out.

Having regard to the basic data, it is always sufficient to give the IRR to the nearest whole number.

Table VII

Calculation of Internal Rate of Return
Port and Processing Project - Paita, Peru

U.S.$ '000

Year	Capital Costs	Recurrent Costs	Total Costs	Total Benefits	Net Cash Flow	Discount Factor 23%	Net Present Worth	Discount Factor 26%	Net Present Worth
1	873		873		- 873	.813	- 710	.794	- 693
2	4 512		4 512		-4 512	.661	-2 982	.630	-2 842
3	2 330	1 920	4 250	2 696	-1 554	.537	- 834	.500	- 777
4	680	3 720	4 400	5 130	730	.437	319	.397	290
5		4 671	4 671	7 806	3 135	.355	1 113	.315	987
6		7 427	7 427	10 422	2 995	.289	865	.250	749
7		7 512	7 512	10 572	3 060	.235	719	.198	606
8	1 000	7 512	8 512	10 572	2 060	.191	393	.157	323
9		7 512	7 512	10 572	3 060	.155	474	.125	382
10a/	500	7 512	8 012	15 972a/	7 960	.126	1 003	.099	788
							360		- 187

a/ Including Residual Value 5 400

IRR = $23 + 3 \times \frac{360}{547} = 24.97 = 25$ percent

The IRR is not difficult to compute once the method is understood, and the project period limited to 20 or 25 years. Where unlimited capital and other necessary inputs such as management capability are available, all projects with an IRR greater than the opportunity cost of capital may be accepted. Where this is not the case, as is usual, the IRR will give a correct ranking among non-mutually exclusive projects, and the one with the highest IRR should be chosen. Where the projects under consideration are mutually exclusive, the IRR may give an erroneous indication of the worth of the projects, giving more importance to a smaller high-yielding project than to a larger one (judged from its contribution to total wealth), which still yields more than the opportunity cost of capital. In this case, as described earlier (page 39), the differences between mutually exclusive projects should be discounted to find the marginal Internal Rate of Return on the incremental investment and judge this in relation to the cut-off rate or opportunity cost of capital.

A similar approach may be used in estimating the optimal timing of investment.

The main criticism which has been levelled at the Internal Rate of Return method is that it has no real meaning where the project has large negative cash flows late in the project period. In some cases, where there are large negative cash flows late in the project life, the computation formula may give rise to multiple solutions.

The negative cash flow late in the project period, as for instance where engines in vessels have to be replaced, is not in itself a problem. This is simply to say that some of the returns of the earlier years are re-absorbed in the project, thus lowering its overall rate of return from an early high rate to something more modest. Two or more Yield solutions only arise where the sum of the discounted cash flows from any year, i.e., the late year in which a negative cash flow occurs, up to the end of the project period, is negative. Where this is the case, the project should, where possible, be cut off at the point where the discounted negative present value of future years begins, since the project has turned into a liability.

The problem may be resolved by the Extended Yield method given in Merrett and Sykes, where in effect, the period when the project is a liability, i.e., has a net negative present value, is discounted forward at the normal cost of capital, not the discount rate, year by year, starting with the last and subtracted from the preceding positive cash flows until all cash flows are positive, and the method may be used normally as previously described. This, in essence, is making provision for the years when the project is a liability out of the proceeds of the good years.

This criticism of the Internal Rate of Return method is more theoretical than of practical importance. The simple rule where a project does have large negative cash flows late in its life is first to calculate the IRR normally, and then check that, at this rate, the sum of discounted cash flows of the later period are themselves positive.

4.3 Approximate Methods

The principal drawback, in practice, of the IRR method is the necessity of multiplying each year's Cash Flow by the discount factor chosen, possibly for several rates of interest, until a sufficiently close approximation has been reached. Methods which facilitate an early approximation are clearly helpful provided that their limitations are understood.

We may mention in passing that where the cash flows are constant for a period of years, computation may be facilitated by use of the Cumulative Yield Tables (page 74). If, for instance, the cash flows are constant between years 8 and 15 at U.S.$ 1 000, we can, for example at a trial Rate of Interest of 12 percent, avoid the eight separate multiplications necessary, by entering the Cumulative Table and subtracting from the Discount Factor for Year Fifteen, the Discount Factor for Year Seven (not Eight since we wish to include Year Eight). This gives 6.811 - 4.564 = 2.247 x 1 000 = U.S.$ 2 247, which will be found to equal the separately discounted sum of the annual cash flows.

Where therefore a project has a short initial investment period and fairly constant cash flows, we can form a fairly close approximation of the true rate by finding the discount factor which equalizes the initial capital costs, and the flow of annual benefits. An example will make this clear. Suppose we have a vessel which costs, say, U.S.$ 100 000 and which in a normal year of operation is expected to produce net benefits of U.S.$ 15 000 for 15 years, we know that it will not achieve this in its first or probably second year. However, ignoring this, if we divide the Capital cost by the average annual returns,

$$\frac{100\ 000}{15\ 000} \text{ we get } 6.667$$

Entering the Cumulative Table, we see that this discount factor, at year 15 lies between 12 and 13 percent, which gives us a rate at which to start our trial and error computations.

If the project is in fact of the following form:

Year	1	2	3	4-15
	-60 000	-40 000	+10 000	+15 000

the true Present Value at 12 percent is -12 205, which indicates that the true yield is lower. At 8 percent it is 7 700 and we can interpolate finding the true IRR to be:

$$8 + 4 \times \frac{7.7}{19.7} = 9.4 \text{ percent}$$

Where the benefit flow is not constant, we can make a rather less approximate first estimate by taking the annual average benefits over the project life, that is we choose a likely rate of interest at which we:

(a) Discount the Capital Expenses to Year 1;

(b) Using the Cumulative Tables, discount Average Benefits to Year 1;

(c) Discount the Residual Value to Year 1.

Then, minus (a) plus (b) plus (c) equals Net Present Value approximately at the selected Rate of Interest. If it is negative choose a lower rate of interest and vice versa, until the NPV is negligible, and this will give a starting point for the computation proper. This essentially is the proper form of computation, but by assuming that the returns per year are constant, simplifies the calculation through the use of the Cumulative Table.

We should perhaps stress that this approximate estimate is only a guide to shorten the trial and error computation of the IRR and does not provide a valid comparison between projects. In particular it also makes no allowance for Residual Values, though these, as we have seen, have a relatively small influence on the IRR.

A more detailed and consequently more accurate method for the first approximation of the Internal Rate of Return is given in J. Price Gittinger, and is here reproduced with the permission of the World Bank.

"Initial Estimate of the Internal Rate of Return

(Assumes internal rate of return
less than 100 percent and investment-type activity)

Using the cash flow, following the step below:

Step 1

Determine:

$$\frac{\text{Average annual benefits}}{\text{Total initial costs}} = \text{Estimated internal rate of return in decimal terms (i.e., not percent)}$$

Step 2

Reduce the estimate in Step 1 by subtracting the amount indicated:

Duration of the Benefit Stream (Years)	Estimated value in Step 1			
	Less than 0.1	0.1-0.2	0.2-0.3	More than 0.3
5	-	-	0.18	0.13
10	0.08	0.07	0.05	0.02
15	0.05	0.03	0.02	0.0
20	0.02	0.01	0.0	0.0
More than 25	0.0	0.0	0.0	0.0

Step 3

Reduce the Step 2 estimate by the amount indicated for the number of years in the investment period:

Investment Period	Subtract from Step 2 Estimate
1	0
2	1/2 (Step 2 Estimate) 2
	(Step 2 Estimate) 2
	1.5 (Step 2 Estimate) 2
	2 (Step 2 Estimate) 2

Step 4

Reduce the Step 3 estimate by the amount indicated for the lapse between the end of the investment period and the time of the first benefits:

Lapse (Years)	Subtract from Step 3 Estimate
1	(Step 3 Estimate) 2
2	2 (Step 3 Estimate) 2
3	3 (Step 3 Estimate) 2
4	4 (Step 3 Estimate) 2
5	5 (Step 3 Estimate) 2

Step 5

(a) If benefits are larger in early years than later years, increase the Step 4 estimate somewhat;

(b) If benefits are greater in later years than in early years, decrease the Step 4 estimate somewhat.

Step 6

Shift the decimal point two places to the right to obtain the estimated internal rate of return in percentage terms (i.e., Step 5 estimate x 100).

(Source: Economic Development Institute teaching materials prepared by Frank H. Lamson-Scribner)"

4.4 Other Uses of Discounting Methods

We have described the principal discounted cash flow measures of worth, and the different data bases of financial and economic project analyses. The Internal Rate of Return can and should be used for both analyses, and it is more usual to use the Benefit/Cost Ratio for the economic analysis.

It is possible to use the same methods to illustrate particular aspects of the project, among which we may particularly mention:

(a) The return to the project authority's equity

If the project has first been evaluated by the financial return on all assets employed, regardless of their financing, i.e., as a "pure" project, we should now show the return to the project authority's own invested capital, assuming, or knowing, that some part of the total is to be borrowed. This is done by counting in the cash expenses, additional to the authority's expenditures, the interest on borrowed capital, as and when paid, the benefits of the project remaining the same.

(b) The return on foreign exchange employed

It is often important to the Government to know that their scarce foreign exchange resources are being wisely utilized. This may be done by including in capital and operating costs only those items requiring foreign exchange at the national level, i.e., not just at the project level, where for instance, fuel oil will be purchased in local currency and separating the benefits into two elements, those accruing in foreign exchange, e.g., from exports and those accruing in local currency through domestic sales. If the latter are converted to foreign currency at the shadow foreign exchange rate, the total of the benefits, in relation to the costs, gives the rate of return, or Benefit/Cost ratio, from the use of foreign exchange.

(c) Internal comparison of project variants

We have mentioned (page 23) the question of ensuring in the project design stage a proper scale of the project, a proper timing and a proper choice of available technologies. These are all aspects of a common problem, that of choosing between mutually exclusive possibilities, i.e., where only one option can be chosen.

If Financial Cash Flows statements are prepared for each alternative, the differences in their Net Cash Flows can be discounted to show the incremental rate of return to the additional investment. Where this is above the cut-off rate of borrowing rate of interest, the more expensive project should be selected. Alternatively, the Net Present Worth may be used, choosing the variant with the higher NPV.

Similarly delays in the timing of the project may show, if the benefits increase over time independently of the start of the project, that a deferred start will show a higher rate of return than an immediate start. This problem is best approached by the Net Present Value method.

Where the benefit streams are broadly the same whatever technology is chosen, or in cases where the benefits are difficult to evaluate, discounting methods often help to elucidate the choice between different technologies, for instance between machine and hand processing, or between using ice or shipboard refrigeration installations. This is done by comparing the cost streams, not the Net Cash Flow, of the competing alternatives. The typical situation is that where a higher initial investment cost is offset by lower operating costs, or vice versa, that is a question of capital intensity. There will be one unique rate of discount at which the Net Present Value of the two cost streams is the same, and this is known as the Crossover (or Equalizing) discount rate. If the cost of capital, or the cut-off rate, is higher than the Crossover Rate, the lower capital-intensive option should be chosen and vice versa.

These methods are of importance at the design stage of the project, prior to the evaluation of a concrete and well defined project, but the results of these analyses should be included in the project report in order to forestall or limit subsequent criticisms of neglect of alternative possibilities.

4.5 Risk and Uncertainty

We have been at pains to stress that fisheries projects are, by their nature and dependence upon a biologically renewable resource, subject to a high degree of uncertainty in the estimates of basic

relationships such as catch rates, prices, etc. The data employed in the financial and economic analysis will be the best or most likely estimates of these important variables. It is, however, very important to the decision-makers to know what effect on the project as a whole departures from these values will have.

Techniques exist for the calculation, by probability analysis, of the mathematical likelihood of any given interaction of values of the principal variables, and hence the likelihood of a given rate of return. This technique, besides being computationally involved and requiring the use of a computer, also depends upon good estimates of the standard deviations, over a number of trials, of the values of the principal variables, information which is generally not available to the project analyst. The various specialists providing the data may be asked to state, say, 90 percent Confidence Intervals for their estimates from which upper and lower boundaries of the Rate of Return may be calculated. This has the advantage of shifting responsibility from the project analyst to the specialist, for the reliability of the estimates, but does not really solve the problem. The principal guide which the project analyst can give the decision-taker is in the form of Sensitivity Analysis.

4.5.1 Sensitivity analysis

In this analysis we simply recalculate the Net Cash or Benefit Flows, using lower values for the parameters whose sensitivity we wish to test, and from these recalculate the Internal Rate of Return or other indices of worth. The important parameters may vary from project to project, but in general for fisheries projects, sensitivity analysis should include the effect upon the project of:

(a) Lower yields than anticipated;

(b) Lower prices than anticipated;

(c) Higher operating costs than anticipated;

(d) Cost over-runs, i.e., where the initial capital investment and the creation of an operational organization takes longer than usually anticipated.

The degree of departure from the original estimates to be used in the sensitivity analysis is a matter of informed judgement, depending upon the analyst's view of the biological situation, or the degree of knowledge he has about the market situation, etc., and it is difficult to give general rules. A typical case for instance might give the Rate of Return of the project assuming 5 and 15 percent lower prices, 10 percent lower catches and perhaps a 10 percent increase in operating costs. Table A gives an example of the calculation. It is not usually necessary to show the detailed calculations, but the results should be displayed in a table, such as Table B, which, apart from the specific information which is shows, permits a subjective evaluation of the relative importance and impact on profitability of the factors considered.

This approach sets out the analyst's view, let us say, of the most pessimistic outcome of the project, and since his knowledge is, at the stage of project analysis, the most comprehensive available, it is of real guidance to the investment decision.

It does not of course strictly measure the sensitivity of the project to variations in specific parameters. For this, the important values should be changed by the same fixed amount, say 10 percent, and the resulting changes in the IRR will show which factors, be they yields or costs or prices, etc., are of the greatest importance and which merit the greatest consideration in refining the estimates.

We have mentioned the difficulty of satisfactorily estimating shadow prices for labour inputs and foreign exchange. The sensitivity analysis may be used to determine the relative importance of these factors in the economic analysis and hence to show whether the detailed calculation and use of such shadow prices are worthwhile.

The evaluation of the probabilities of the various pessimistic assumptions, i.e., how likely is it that for instance market prices will be 10 percent lower than originally estimated, is essentially a matter for the subjective feelings of the decision-maker. If, however, the analyst, on the basis of expert advice, can assign probabilities to the pessimistic assumptions; for instance, if he can say that the probability of a price lower than 90 percent of the original estimate is not more than 20 percent, and similarly for the other assumptions, he can calculate the overall probability of the outcome, i.e., the revised rate of return, being less than stated.

TABLE A

Port and Processing Project, Peru
Most Probable Outcome (Table VII) IRR - 25 percent

Assuming 10 percent Lower Frozen Fish Price

Year	Total Costs	Total Revenues	Net Cash Flow	Discount Factor 20%	NPV	Discount Factor 15%	NPV
1	873		- 873	.833	- 724.6	.870	- 759.5
2	4 512		-4 512	.694	-3 113.3	.756	-3 411.1
3	4 250	2 461	-1 789	.579	-1 019.7	.658	-1 177.2
4	4 400	4 661	261	.482	125.8	.572	149.3
5	4 671	7 110	2 439	.402	980.5	.497	1 212.2
6	7 427	9 484	2 057	.335	678.8	.432	888.6
7	7 512	9 634	2 122	.279	572.9	.376	797.9
8	8 512	9 634	1 122	.233	258.1	.327	366.9
9	7 512	9 634	2 122	.194	403.2	.284	602.6
10[a]/	8 012	15 034[a]/	7 022	.162	1 123.5	.247	1 734.4
					- 714.8		404.1

a/ Including Residual Value 5 400

$$IRR = 15 + 5 \times \frac{404}{1\,119} = 16.8 \text{ percent} = 17 \text{ percent}$$

TABLE B

Effect of Changes in Basic Assumptions of the Project

Change in:	Output Prices	Catches	Investment Period	Operating Costs
Extent %	-10	-10	1 year	15
IRR %	17	20	17	14

4.5.2 Capital recovery period (discounted payback)

Apart from the major uncertainties regarding the costs and revenues of the project, another major uncertainty in the minds of investors is the likelihood of the project running its full planned period, or the possibility of some major change in the project environment taking place before termination. In the case of fisheries projects these risks embrace the possibility of a catastrophic diminution of yields due to natural causes or greatly increased fishing effort over which the project sponsors have no control, or, often in the case of overseas investment, the possibilities of political changes, expropriation or nationalization, rules for local majority control, or future loss of fishing licences. In such cases, as we have mentioned in this Chapter (4.1.3) the discounted Capital Recovery period calculation will give the investor a basis for his subjective evaluation of the probabilities.

This information can be shown in a table of the following form. (Data as for Table VI.)

TABLE VIII

Rate of Interest on Capital	0	10	15	20	24
Years to Recovery	5	6.4	7.6	9.8	15 (Planned Project Life)

The method should, of course, make provision where possible for recovery of capital assets on premature termination or for the terms of compensation, if these can be assessed. Much depends upon the particular risk that is contemplated and the precise form of organization of the project. Where possible and appropriate the capital invested may be divided into two parts, that which is mobile and recoverable in most circumstances, e.g., vessels, and that which is clearly committed, such as shore processing plants and the analysis made on the basis of the capital at risk.

4.5.3 Break-even estimates

The foregoing calculation of the payback period, in that case project period, either discounted or undiscounted, is essentially a variation of break-even calculations in general, i.e., the estimation of the value of an important parameter at which the project just covers its costs.

For fisheries projects involving process type operations where there is a relatively large element of fixed capital and where therefore fixed costs are substantial, regardless of the level of throughput, it is often useful in the estimation of risk and uncertainty to calculate the break-even level of throughput. For this, the total costs of the project, including depreciation and interest on capital, have to be separated into two parts, a fixed element invariable with respect to throughput, and variable costs, which are proportionate to throughput. Of course, some cost elements do not fall neatly into one or other category and considerable judgement is necessary. What is a variable cost depends in large part upon the time period under consideration. As a general rule, we take a typical year when the project is established and in full operational service and calculate Variable Cost per Unit of Output, C_v.

Since to break even, Fixed Costs (C_f), plus Variable Cost per Unit times total output, i.e., Total Costs, must equal Total Revenue, which is Total Output (O) times unit Price (P) we have:

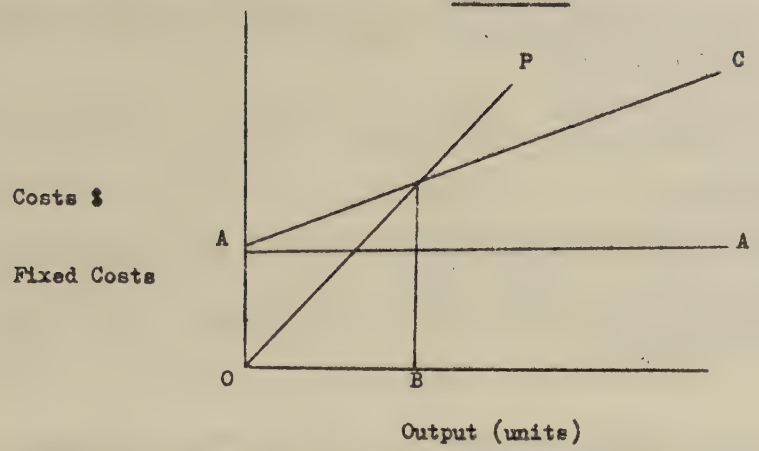
$$C_f + (C_v \times O) = O \times P$$

$$\text{or} \quad O = \frac{C_f}{P - C_v},$$

that is, Break-even Output is that at which Fixed Costs are just covered by the margin between price and unit variable costs. This may be illustrated diagramatically as shown in Fig. II.

The Fixed Costs are shown as AA, invariable with respect to output, and Unit Variable Cost is given by the slope of line AC. The Unit price is given by OP, and at the intersection of these lines, at an output of OB, Costs and Revenues are equal.

FIGURE II



A more sophisticated analysis involving curvilinear cost and revenue functions can be done, for existing plants where good data are available, but is not usually worthwhile on the data available in project planning.

Similarly, if the planned output is known or assumed, the break-even sales price of output may be calculated. The break-even analysis may be made not only for the most likely or design parameters of the project, but also for assumed variations in prices, etc., thus showing necessary minimum levels of system throughout for a range of assumptions about prices and costs.

The probabilities of the break-even price or throughput not being attained are again largely a matter for subjective assessment in the light of the supply and market situations, though if they can be estimated, the break-even point may be given a degree of probability. In most cases this is not possible. However, the explicit statement of this aspect of the project design will be of help to the assessment of risk in the investment decision.

CHAPTER V - Conclusion and Guidelines

We have now discussed in a general and not too technical manner the process of fishery project identification and formulation, from the general appraisal of the fisheries sector to the preparation and evaluation of a specific fisheries project.

For more detailed consideration of particular aspects, or refinements of technique, as well as a fuller treatment of the economic basis of project appraisal, the reader is referred to the bibliography.

5.1 Assistance in Project Preparation

It will have become apparent that, but for all except the simplest fisheries projects, project identification and formulation is generally a lengthy process, involving a wide range of disciplines and techniques. It can be rather costly, particularly where substantial investigations have to be made. Many governments in developing countries will wish to avail themselves of professional and financial services for project preparation.

5.1.1 Professional services

The principal source of technical assistance for the preparation of fisheries projects is the Department of Fisheries of FAO, through its field projects and Regular Programme personnel, and especially through the Fishery Industries Development Service whose essential function is the identification and promotion of fishery development projects. Also within FAO are the fisheries specialists of the FAO/Development Bank Cooperative Programmes whose services are available to governments for project formulation and appraisal. The World Bank has staff fisheries personnel whose advice may also be sought.

In the private sector, there are a number of individuals and consulting companies engaged in fisheries development generally and, specifically, in offering advice and technical services in fisheries project preparation.

5.1.2 Financial assistance

The financing of such specialist assistance in project preparation may be sought, principally, from:

(i) The United Nations Development Programme, who finance special projects for pre-investment studies, and identification and preparation services, or who, most often, finance pre-investment studies as part of FAO/UNDP fisheries field projects.

(ii) The International Development Banks, who finance identification, preparation and appraisal missions, either directly or through the FAO/Development Bank Cooperative Programmes. On some occasions and under certain circumstances, Bank loans or credits are available for pre-project activities including formulation and appraisal of projects.

(iii) Bilateral assistance agencies, who have on numerous occasions, assisted governments in the financing of investment studies, either directly or through the provision of the services of national consulting firms.

5.2 The Guidelines

We include two suggested Guidelines in Annexes A and B whose purpose is to provide a check-list of the information to be included in fishery project reports, and to provide a more standardized format for such reports. They largely follow upon the treatment of earlier chapters of this Manual.

The differences between the two sets of Guidelines are small, and in general, confined to Sections III and IV. Guideline A should be regarded as the basic form for most fisheries projects of a production or marketing character, where the project output is in the form of identifiable goods and services, whose valuation, by means of market or shadow prices, poses no conceptual problem and where the direct beneficiaries of the project are also readily identifiable.

It is felt however that for major harbour or port projects, as indeed most infrastructural projects, special treatment is justified. There are various reasons for this. Harbour and port projects are usually large, complex and with long gestation periods, often involving substantial pre-project costs in site investigations, etc. Of particular significance however is the fact that the direct and

indirect benefits of the project are not fully reflected in the Cash Revenues of the project, but are dispersed generally through the fisheries sector. The benefits of infrastructural projects are spread over a large number of users and associated activities. Most often, only a part of the benefits is in the form of direct services, such as berthing space, for which a charge can be made upon the user. Since the harbour project authority has, almost by definition, a monopoly of the supply of its services within its area, there is generally no objective market price with which to value its output, and the valuation of its services has to be done indirectly by calculating their value to the user.

These factors lead to a significant difference of emphasis in the treatment of the project's financial feasibility as contrasted with the estimation of "social" or external costs and benefits. We may say as a rough generalization that for infrastructural projects, the latter are the primary concern, whereas for production and marketing projects, the financial aspects are critical, and to some extent, the social costs and benefits are of secondary importance.

In infrastructural projects it is necessary to categorize, prove and quantify the existence of the direct benefits, wherever they occur, such as in the use of more efficient vessels, more days' fishing through improved turn-round, lower handling and marketing costs through improved layout, etc., before comparison can be made with the costs of the project.

The first step in project analysis for infrastructural projects is then to estimate the economic Rate of Return of the project, i.e., regardless of where the costs and benefits accrue. This is necessary to select the best project from alternative formulations or locations and to compare it with alternative uses of scarce investment funds. The financial analysis of the project from the project authority's point of view normally poses a number of problems, particularly of "structure" and operational responsibility which need to be resolved or hypothesized at the project formulation stage. Because of the dispersion of benefits, the returns to the project authority are generally low. In terms of overall economic costs and benefits the project may be justified, but nevertheless, the project authority at minimum needs a sufficient cash flow to meet its liabilities. It is not proposed here to enter into detailed discussion of rate and charges structures, but it is clear that where possible, the authority's revenues should derive from, and preferably be proportional to, the benefits accruing to external operators, the primary beneficiaries of the project. This often poses problems in practice.

Of course, in some cases, the external and social benefits of the project such as employment generation, foreign exchange contribution, etc., may justify continuing subsidy finance to the project authority from central government sources. This should generally be conceived in relation to capital charges, and not recurrent annual operating costs.

It will be apparent however that whereas production projects may be conceived of at the formulation stage as "pure" unstructured projects, details of their financing being decided after negotiations at the loan application stage, these questions of financing and particularly of revenues must, for infrastructural projects, be substantially resolved in the project formulation.

It is not intended in these Guidelines to deal with the more technical aspects of project design. It will be clear that the first requirement for a good project is a good technical solution to the problems involved and this most often will involve trial and error cost analysis using the techniques presently described. It is worth noting however that the establishment of the scale of the project and its principal design parameters requires a good knowledge of the effects of the project upon the fishing industry. As an example, we may say that the estimation of necessary berthing and unloading quay space in a new fisheries harbour, preferably by means of queueing theory, presupposes a knowledge of the numbers, sizes and types of vessels, their fishing cycles, and their expected catches. A good design of market hall requires prior knowledge of landings, species composition and utilization and selling methods. Much useful information on these matters can be found in "Fishing Ports and Markets" (see Bibliography).

5.3 Presentation of the Report

We suggest that the project report should generally follow the layout of the Guidelines.

Some judgement is required as to how much of the prior trial and error analysis to include in the final project formulation report. Those interested in the report, government departments, investors and financing institutions, are naturally anxious to know not only that the selected project is feasible and attractive, but also that, of the total set of technical and economic alternatives, it is reasonably close to the best available. At the same time the final report does not need to be too dense with detailed consideration of all possible alternatives, and the project analyst has to use his judgement. Much depends of course upon the nature of the project and its environment, but in the

author's purely personal opinion, matters of Size, Location and Employment Generation are particularly sensitive areas with government project sponsors, with the rate of return, foreign exchange cost and risk factors somewhat less so. The international financing institutions have different standards of course but appear generally to fall in with the government's view of its priorities. During the project formulation stage, the project analyst should take particular note of sensitive questions, differences between departments of government and the views of possible financing sources to assist him in determining how much detailed argument various sections of the report will warrant.

One should bear in mind that the principal readers of the report will be non-technical, non-fisheries administrators to whom falls the responsibility for the final investment decision and its financing. Quantitative data should be clearly displayed in simple tables and diagrams where possible, and supporting data and calculations shown in a separate annex to the report.

Provided the basic data, e.g., the Cash Flows and their origins, are shown clearly, it is not normally useful to show in detail the calculation of the Rate of Return, since the methods will be well known to those responsible for appraisal of the report.

ANNEX A

Guidelines for the Preparation and Analysis of Fish Production and Marketing Projects

I. Introduction

1.1 The Economic Situation of the Country

1.2 The Existing Fisheries Situation

- 1.2.1 Landings, totals by species, utilization, etc.
- 1.2.2 Numbers and types of vessels
- 1.2.3 Fishermen
- 1.2.4 Ports and facilities
- 1.2.5 Fish in national nutrition
- 1.2.6 Markets and marketing system
- 1.2.7 Government organizations and institutions

1.3 Brief Description of Project

- 1.3.1 Basic aims of project
- 1.3.2 Brief outline of project
- 1.3.3 Estimated costs and benefits of project
- 1.3.4 Administrative organization of project

II. Background to the Project

2.1 The Natural Resource Basis

- 2.1.1 Fishing area or grounds, location, productivity per unit effort, present effort, estimated maximum sustainable yield, existing research situation
- 2.1.2 Statistics of landings, total; by species, etc.
- 2.1.3 Commercial characteristics of principal species, sizes, colour, oil content, acceptability, etc.
- 2.1.4 Seasonal variations

2.2 Manpower and Institutions

- 2.2.1 Numbers and types of fishermen
- 2.2.2 Numbers and types employed in processing, marketing, etc.
- 2.2.3 Numbers and types of supervisory staff
- 2.2.4 Relevant existing fishery institutions

2.3 Infrastructural Facilities

- 2.3.1 Numbers, types, capacities, etc., of ports and landing places
- 2.3.2 Existing facilities: ice, shipping, water, fuel, etc.
- 2.3.3 Communications

2.4 Marketing Analysis

- 2.4.1 Analysis of past and present demand; forecast of future demand and prices
- 2.4.2 Existing market channels and structures
- 2.4.3 Margins
- 2.4.4 Trade policies

2.5 Other Factors

- 2.5.1 Tariff policies
- 2.5.2 Financial incentive schemes
- 2.5.3 Etc.

III. Description of the Project

3.1 Summary of Basic Assumptions of the Project

3.2 The Basic Objective of the Project

3.3 Location of the Project

3.4 Description of the Physical Investment

- 3.4.1 Vessels
- 3.4.2 Market Facilities
- 3.4.3 Port Facilities
- 3.4.4 Processing Plant
- 3.4.5 Etc.

3.5 Other Non-Investment or Non-Project Inputs

3.6 Project Output

- 3.6.1 Quantity of direct output of different types
- 3.6.2 Prices and values
- 3.6.3 Project direct revenues

3.7 Timing and Phasing of Investment

3.8 Justification for the Size of the Project

3.9 Administrative and Organizational Structure of the Project

IV. The Analysis of the Project

4.1 Financial Analysis

4.1.1 Project financial return

- (a) The investment schedule
- (b) Annual operating costs
- (c) Project revenues
- (d) Residual values and project period
- (e) Net cash flow statement
- (f) Internal financial rate of return of the project

4.1.2 Breakdown by project elements

- (a) Internal rate of return of project elements
- (b) Justification of project balance

4.1.3 Analysis of risk

- (a) Sensitivity analysis
- (b) Payback period
- (c) Breakeven point

4.2 The Economic Analysis

4.2.1 Non-financial costs and benefits

- (a) Taxes and duties
- (b) Shadow prices
- (c) Other indirect costs and benefits

4.2.2 Net annual economic cash flow of the project

- (a) Internal economic rate of return of the project
- (b) Social benefic/cost analysis

4.2.3 Analysis of risk

4.3 The National Economic Effect of the Project.

4.3.1 Contribution to gross national product
4.3.2 Contribution to regional balance of development
4.3.3 Contribution to foreign exchange balance
4.3.4 Contribution to nutrition
4.3.5 Contribution to employment
4.3.6 Etc.

4.4 Financial and Organizational Aspects of the Project

4.4.1 Sources and uses of funds
4.4.2 Optimal capital structure; gearing
4.4.3 Rate of return on equity
4.4.4 Timing of financial flows
4.4.5 Cumulative cash balances

V. Conclusions and Recommendations

5.1 Conclusions

5.2 Outstanding Issues

5.3 Proposals for Subsequent Action

(a) Further investigations and preparation
(b) Sources of financing
(c) Etc.

ANNEX B

Guideline for the Preparation and Analysis of Fishery Harbour and Basic Infrastructural Projects

I. Introduction
II. Background to the Project
} As in Annex A

III. Description of the Project

3.1 Summary of the Basic Assumptions of the Project

3.1.1 Landings, species, seasonality, etc.
3.1.2 Expected fleet; sizes, types, cycles of operation, etc.
3.1.3 Expected marketing and processing structure, products, etc.

3.2 The Basic Objective of the Project

3.3 The Location of the Project

3.3.1 Physical conditions
3.3.2 Hydrography
3.3.3 Siltation
3.3.4 Distances from grounds, markets, etc., transport facilities
3.3.5 Availability of services
3.3.6 Availability of manpower

3.4 Description of Major Works and other Physical Investment

3.4.1 Dredging works
3.4.2 Land fill and reclamation
3.4.3 Piers and quaysides
3.4.4 Facilities; slipways, cranes, pumps, etc.
3.4.5 Buildings; market halls, processing plants, etc.
3.4.6 Etc.

3.5 Timing and Phasing of Works

3.6 Administrative and Organizational Structure of the Project

3.6.1 The project authority
3.6.2 Governmental responsibilities
3.6.3 Management of the project

IV. The Analysis of the Project

4.1 The Economic Analysis

4.1.1 Non-cash costs and benefits

(a) Taxes and duties
(b) Shadow prices
(c) Other indirect costs and benefits
(d) Total non-cash and indirect costs and benefits

4.1.2 Project beneficiaries and estimated direct benefits

(a) Vessel operators; evaluation of direct benefits from improved fishing time, lower costs, larger vessels, etc.
(b) Marketing processing sector; evaluation of direct benefits from: improved supplies, better quality, lower costs, etc.
(c) Other direct benefits
(d) Total direct benefits

4.1.3 Project economic return

(a) The investment schedule; allocation of joint costs
(b) Annual operating costs; allocation of joint costs
(c) Residual value of works and project period
(d) Net project benefits; direct and indirect
(e) Annual net costs and benefits
(f) Internal economic rate of return
(g) Social benefit/cost ratio

4.1.4 Analysis of risk

(a) Sensitivity analysis
(b) Payback period
(c) Break-even

4.2 Financial Analysis; Project Authority

4.2.1 Project beneficiaries and project revenue structure

(a) Harbour dues
(b) Berthing charges
(c) Rents
(d) Services
(e) Other revenues
(f) Forecast of total revenues to project authority

4.2.2 Net annual cash flow of project authority

(a) Internal financial rate of return
(b) It will often be of interest at this point to estimate the residual net benefits of the project to the fisheries sector by subtracting 4.2.1 from 4.1.2

4.2.3 Analysis of risk

(a) Sensitivity analysis
(b) Payback period
(c) Break-even

4.3
4.4 } As for Annex A
5.

APPENDIX I

Typical Questionnaire for Fisheries Sector Review

Introduction

It may be the case that a fisheries plan has already described the main structure and features of the existing industry. If not, this must be the first task of the project identification team. What is required is a description, in as much detail as is available, of:

(a) The fish resources, both presently exploited and potentially available, their physical and commercial characteristics, seasonality, etc.

(b) The size and type of the existing fleet, manpower engaged, types of gear, harbours and landing places.

(c) Markets, present consumption, product forms, etc.

(d) Existing institutions and government services, etc.

Without this general body of knowledge of the existing situation, little progress can be made with project identification.

However, the principal problem with which we are concerned at the moment is the identification and selection for further study of potentially feasible investment situations. In this initial stage, before more detailed calculations are undertaken, we should be less concerned with the financial feasibility of possible projects as with their technical feasibility, i.e., the possibility of finding technically adequate solutions to a given set of circumstances. The present objective is not indeed directly to identify a specific project, but to identify and define a promising investment situation.

To this end it is often useful to submit the information available to the type of scrutiny contained in the following check-list which because of the large variety of possible situations cannot pretend to be exhaustive, but such a list or a variant of it which should be prepared by every project analyst, helps reveal constraints and obstacles to development, and suggest the main outlines of technically feasible investment opportunities. Whilst much remains to be done in designing, dimensioning and costing possible projects, such a logical scrutiny as outlined in the questionnaire may save some time and limits the tendencies of various specialists to ride their hobby-horses.

The questionnaire, which may better be regarded as a check-list, poses the minimum number of questions necessary to determine the existence of an investment situation and to reveal whether sufficient information exists for detailed project preparation and pre-feasibility analysis, or whether more information-gathering activity is necessary. It may be addressed to a resource, a location or with respect to market factors.

Model Questionnaire For Reviewing and Identifying Fishery Sector Projects

1. Is there evidence that:

   (i) a fishable resource exists,
   (ii) a market for some product form of this resource exists

2. Resource Characteristics

   2.1 Size, (i) Sustainable yield, or
   (ii) Conservation catch available

   2.2 Present catch

   2.3 Distribution in space

   2.4 Distribution in time (i) Annual variation
   (ii) Seasonal variation

2.5 Range of uncertainty of above estimates

2.6 Commercial characteristics:

(i) Species
(ii) Size composition
(iii) Oil content by season
(iv) Water content
(v) Spoilage characteristics

3. Markets

3.1.1 Total immediate potential market (FWE = Fresh weight equivalent)
3.1.2 Local
3.1.3 International

3.2.1 Total future potential market
3.2.2 Local
3.2.3 International

3.3 Product form Unit prices

3.3.1 Fresh
3.3.2 Frozen
3.3.3 Canned
3.3.4 Fishmeal

3.4 Transport

3.4.1 Mode
3.4.2 Distance
3.4.3 Do facilities presently exist
3.4.4 Cost

3.5 Market Organization

3.5.1 Does market structure exist

4. Fishing Technology

4.1 Proposed catching method
4.2 Vessel size; type, cost, including gear
4.3 Capacity
4.4 Range
4.5 Estimated daily catch rate
4.6 Trip length
4.7 Do operating facilities exist: Unloading, Berthing, Fuel, Labour, Repair

5. Processing Technology

5.1 Product forms
5.2 Capacity: Daily FWE
5.3 Capacity: Annual FWE
5.4 Operating days

6. Output Annually

	Number	Unit Price	Total Value
6.1 Product A			
6.2 Product B			
6.3 Product C, etc.			
6.4 Projected Totals			

7. Availability of Inputs

7.1 Labour, skilled
7.2 Labour, untrained
7.3 Water
7.4 Fuel

8. Location

8.1 Distance from fishing grounds
8.2 Distance from primary market

9. Project Elements | Type | Number | Unit | Cost | Total

9.1 Physical Investment Input

9.1.1 Fleet
Vessels
Gear
9.1.2 Processing
9.1.3 Marketing
9.1.4 Transport
9.1.5 Harbour Works
9.1.6 Physical Investment Inputs Total

9.2 Associated Activity Inputs

9.2.1 Administration
9.2.2 Research Activities
9.2.3 Training Activities
9.2.4 Associated Activity Inputs Total

9.3 Project Total

Notes on the Questionnaire

The following comments are relevant in relation to certain questions:

1. The answer to both parts must clearly be positive if the examination is to proceed.

2.1 It is desirable, but not necessary, to know the maximum sustainable yield as an upper boundary. More important is to have a reasonably conservative estimate of the potential catch available, with a high degree of probability as a maximum safe dimension of any project.

2.3 It is vital to know in general the spatial distribution of the resources as this basically determines, in relation to shore bases, the range, and hence type of the vessels.

2.4.1 Distribution in time similarly determines the rate of use of the vessels and optimum plant and base capacities, as well as the degree of risk of the project.

2.4.2 A real knowledge of seasonal resource availability is necessary to dimension the fleet and processing capacities, as well as to design the vessel and plant.

2.5 Overall, some indication of the confidence interval of the above estimates should be given to enable assessment of the risk.

2.6 Apart from the general size and distribution of the resources, commercially important characteristics of the catch must be specified if market potential and processing costs are to be properly assessed. Which of these are most relevant will depend upon particular cases.

3.1 Both immediate and future market potentials must be assessed, the former indicated by
3.2 market shortages, substitutable imports or buoyant international markets, in relation to which the proposed output is small, and the latter, by estimates of population and income

growth, world demand, substitution. At the primary stage, this should not be done in great detail, but the existence of an immediate market at going prices must be shown.

3.3 The form(s) in which the catch will be marketed should be specified, covering all reasonable possibilities and unit prices estimated ex-factory.

3.4 Particularly in new fisheries, transportation of output should be assessed. Do transport facilities exist, or must they be provided at the cost of the project.

3.5 Is there an existing market channel or must a new organization be created for the project. Whilst the foregoing questions review the information required, questions 4 through 8 attempt to assess the technological feasibility of a project without, at this stage, having regard to its economic outcome. Can a workable project be formulated which is consistent in the matching of inputs and outputs at its various stages, which is consistent in its catch rate and distance assumptions and conforms to any known constraints.

4.1 to 4.5 These establish the principal parameters of the catching operation, whilst 4.7 determines the existence, or the need to provide, operating facilities.

5.1 to 5.4 This similarly defines the processing or marketing side of the operation.

7. and 8. In considering a general situation, engendered perhaps only by the known existence of a resource, there may be wide latitude in the choice of location of fishing base or processing facilities. The location will necessarily greatly influence the character of the operation, and optimal location will require a very detailed study, as well as taking into account political and financial factors not considered here. However, a choice of location is implicit in questions 4 and 5 and should be made explicit in questions 6 and 7 possibly with alternative proposals.

9. Recapitulates the main elements of the project outlined in order to assess the size of the project. Physical investment inputs should be specified separately from any organizational or administrative inputs needed for effective implementation.

Review

Except in very concrete instances where all necessary information is available, there is little case for proceeding to an economic appraisal of the project at the preliminary identification stage. The present objective is to review the situation in order to decide whether:

(a) Enough necessary information is available to define a project worth further investigation;

(b) If enough information is available, whether a technologically sound and consistent project can be framed;

(c) If so, is such a project likely on general grounds and, in view of general world prices for inputs and outputs, likely to prove feasible.

If (a) does not hold, the conclusion must be that an investment situation worthy of detailed preparation does not exist, though it may, of course, justify further research and pre-investment study.

If there is adequate information and a project can be defined, the objective is to ensure that it conforms to known facts and is internally consistent. Of particular importance in this connexion are the following:

That the vessel characteristics and operations conform to the resource information, particularly as regards seasonality, trip length and capacity;

That operating facilities are adequate to the fleet. If they do not exist, they must be provided by the project and this must be taken into account;

Having regard to seasonality of landings, does plant or handling capacity conform in an appropriate way?

Questions of range, vessel type and capacity, marketing methods, etc., imply a choice of location. A final decision cannot be made on general considerations, but where appropriate, alternative consideration may be given to treating the fishery as a near-water or distant-water operation. If, for technical reasons, e.g., fishmeal, it can only be treated as a short-range operation, the implications of local provision of facilities should be specified.

Conclusion

It will be appreciated that much of the information cannot be given in sample answer form, and for this reason the questionnaire should be regarded as a check-list. If, however, adequate information exists, it should be possible to define an investment situation in sufficient detail to permit decisions in principle as to the desirability of more detailed project preparation and to justify funding for this purpose.

Alternatively, it will indicate that a number of superficially attractive situations require further research and investigation.

APPENDIX II

Pro Forma Vessels Cost and Earnings Statement

Capital Cost

Vessel
Gear
Working Capital

Total Capital Cost

Vessel Operating Expenses

Fuel Oil
Lube Oil
Ice
Boxes
Crew Provision
Harbour and Landing Costs, etc., and Insurance
Crew Costs
  Basic Wage
  Shares Payment
  Total
Repairs and Maintenance
  Vessel
  Gear
  Total
Management Overhead Costs
Financial Charges
  Depreciation
  Interest

Total Costs

Profit or Loss

TOTAL

Days per Annum
Repairs and Maintenance, etc.
In port between trips
Days at Sea
Days spent Fishing

Catches

	Qty.	Unit Price	Value
Species 1			
Species 2			
Species 3			

Gross Earnings

TOTAL

APPENDIX III

Criteria for Appraisal and Review of Fisheries Projects[1/]

1. Technical Review

1.1 Fishery resources

(a) How have the figures for maximum sustainable yield been arrived at?

(b) Is it likely that further exploratory surveys will discover new resources in the area?

(c) How large are total catches likely to be in the project area in the near future?

(d) How will the seasonal and cyclical variations in overall catches and in catch composition affect the project?

(e) How will possible changes in fisheries resource management affect the project?

1.2 Fishing operations

(a) Is the proposed number of vessels adequate to reach total catch targets?

(b) Are proposed characteristics of vessels adequate for the proposed fishing pattern?

(c) Is the proposed size of vessel an economical size - if not on what grounds has selection been made?

(d) Is the proposed fishing gear the most suitable gear for the vessels selected?

(e) What has been the experience of similar vessels and similar fishing methods in the area?

(f) Are the projected catch rates realistic?

(g) Are the landing facilities adequate for the operations?

(h) What are the possible causes for delays in unloading of fish?

(i) What are the bottlenecks in the fish landing operations and what will be the costs/benefits of removing these obstacles?

(j) Will the proposed methods for preservation of fish satisfy quality requirements?

(k) What are the costs/benefits of improved fish preservation?

1.3 Fish processing and storing

(a) How efficient are the proposed methods for bringing the fish into the plant?

(b) Is the proposed location, size and design of plant technically and economically feasible? What are the main alternatives?

(c) Is the proposed timing for construction and phasing of plants realistic?

(d) What will be the production yield?

(e) Have adequate margins been made for waste in raw material and in finished products?

(f) Will the quality of the products meet market requirements?

(g) Is the capacity of the raw material storage adequate for efficient operation?

(h) Is it technically feasible to produce with more labour intensive techniques and in that case what would be the impact on employment and profitability?

1/ From: J. ENGSTROM Preparation of Fishery Investment Projects IFFC/74/SYM/26 FAO 1974

(i) What are likely to be the main causes of interruption in the operation?

(j) How can plant be utilized (e.g., processing of meat and vegetables) in periods of low fish catches?

2. Commercial Review

2.1 Are the proposed procedures to acquire the vessels to construct the plants, etc., adequate to ensure start of operations according to plan?

2.2 What measures are planned to ensure timely deliveries of electric power, water, fuel, ice, spare parts, packaging material, etc?

2.3 What is the quality of, and how reliable are, the services for repair of vessels, gear and plant?

2.4 Are the project cost figures for all the goods and services realistic?

2.5 If the project is dependent upon deliveries of fish from independent vessel owners and fishermen, what arrangements are proposed to ensure steady supplies?

2.6 How realistic are the demand projections and the sales prices?

2.7 Will the project obtain any special privileges, protective measures, etc., from the government regarding supplies of project inputs or sale of project outputs?

2.8 What are the alternative ultimate consumers of the products?

2.9 If the project, for sale of its products, is dependent on middlemen, sales agents, etc., how efficient and reliable will their collaboration be?

2.10 What are the alternative ways for marketing the fish products?

3. Organization and Management Review

3.1 What is the legal status of the project?

3.2 Has a project organization plan and job description for the key staff been prepared?

3.3 Have the operation objectives been defined?

3.4 What are the functions of the various units and how is it ensured that they will work toward the achievement of the overall objectives?

3.5 Are the monetary and other incentives for the project staff adequate?

3.6 Are the responsibilities given to key personnel matched by delegation of authority?

3.7 Are the experience and the capability of the staff (managers, supervisor, masterfishermen, vessel engineers, refrigeration technicians, fishing crews, etc.) adequate to reach the project targets?

3.8 If foreign technical assistance or training programmes are needed, how will they be provided?

3.9 How efficient are the administrative routines (purchasing, invoicing, cost accounting, budgeting, internal audit, recruitment of staff, etc.)?

3.10 How will the progress of operations be measured and controlled?

3.11 What are the most important bodies or enterprises with which the project will have relationships and how may the effectiveness of these bodies influence the project?

4. Financial Review

4.1 Are the revenues and costs used in the cash flow estimates of the project authority realistic?

4.2 Are the estimated figures for foreign currency requirements, contingencies and working capital adequate?

4.3 How sensitive is the Internal Financial Return to, for example:

- an increase in investment and/or operating costs of 10 percent?
- a delay in finalization of project vessels and processing plant of one year?
- a reduction of projected yearly catches per vessel of 10 percent?
- a reduction in sales prices of 10 percent?
- a reduction in project life of one year?
- a combination of two or more of the above adverse events?

4.4 What is the break-even production volume?

4.5 Are the proposed financing plan and related terms of credits realistic?

4.6 Will the project generate sufficient annual cash surpluses to service its debts?

4.7 What would be the likely source of finance if the project needed additional working capital during its operations?

4.8 Is the project dependent upon annual cash subsidies from the government?

4.9 Is the projected financial return for independent fishing companies, processing plants or other enterprises related to the project activities attractive enough to ensure continuous collaboration during operations?

4.10 If the project is to be undertaken by an existing organization, what are the financial records of the project authority?

5. Economic Review

5.1 Given the overall development objectives of the country, what is the relative priority of the project?

5.2 What is the economic efficiency of the project?

- are the assumptions made for the calculation of Economic Rate of Return valid?
- how does the Rate of Return compare with the return of other rural development projects?

5.3 Who will be the main beneficiaries of the project and how will their incomes be affected?

5.4 How realistic is the calculated project impact on:

- earnings of foreign exchange?
- employment?
- redistribution of incomes?
- regional development?
- food production?

5.5 What are likely to be the forward and backward linkage effects of the project?

5.6 What will be the impact on government revenues?

- what will be the additional public expenditure for infrastructures, supporting services and other elements which are required for efficient project operations, but which are not included among project funds?

- what will be the additional tax incomes?

- will any existing revenues be foregone as a result of the project?

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table A $v_{n,r} = (1+r)^{-n}$

Year	Percentage 1	2	3	4	5	6	7	8	9	10
1	0 990099	0 980392	0·970874	0 961538	0·952381	0·943396	0·934579	0·925926	0·917431	0 909091
2	0·980296	0·961169	0·942596	0·924556	0·907029	0 889996	0 873439	0·857339	0 841680	0 826446
3	0·970590	0·942322	0·915142	0 888996	0·863838	0 839619	0 816298	0·793832	0 772183	0·751315
4	0 960980	0·923845	0 888487	0 854804	0·822702	0·792094	0·762895	0 735030	0·708425	0 683013
5	0 951466	0·905731	0·862609	0 821927	0 783526	0·747258	0·712986	0 680583	0 649931	0 620921
6	0·942045	0 887971	0·837484	0·790315	0·746215	0·704961	0 666342	0 630170	0·596267	0 564474
7	0·932718	0·870560	0·813092	0·759918	0·710681	0·665057	0·622750	0 583490	0·547034	0 513158
8	0·923483	0 853490	0·789409	0·730690	0·676839	0·627412	0·582009	0 540269	0·501866	0 466507
9	0·914340	0 836755	0·766417	0·702587	0·644609	0·591898	0·543934	0 500249	0·460428	0 424098
10	0·905287	0·820348	0·744094	0·675564	0·613913	0 558395	0·508349	0·463193	0 422411	0 385543
11	0 896324	0 804263	0·722421	0·649581	0 584679	0·526788	0·475093	0 428883	0·387533	0 350494
12	0 887449	0·788493	0·701380	0·624597	0·556837	0·496969	0·444012	0 397114	0 355535	0·318631
13	0·878663	0·773033	0·680951	0·600574	0·530321	0·468839	0·414964	0 367698	0 326179	0 289664
14	0 869963	0·757875	0·661118	0·577475	0·505068	0 442301	0·387817	0·340461	0 299246	0·263331
15	0 861349	0·743015	0·641862	0·555265	0·481017	0·417265	0·362446	0·315242	0 274538	0 239392
16	0·852821	0·728446	0·623167	0·533908	0·458112	0·393646	0·338735	0 291890	0·251870	0 217629
17	0·844377	0·714163	0·605016	0·513373	0·436297	0·371364	0·316574	0·270269	0 231073	0·197845
18	0·836017	0·700159	0·587395	0·493628	0·415521	0·350344	0·295864	0·250249	0·211994	0·179859
19	0·827740	0·686431	0·570286	0·474642	0·395734	0·330513	0·276508	0·231712	0 194490	0·163508
20	0 819544	0·672971	0·553676	0·456387	0·376889	0·311805	0·258419	0 214548	0·178431	0·148644
21	0 811430	0 659776	0 537549	0·438834	0 358942	0·294155	0·241513	0·198656	0 163698	0 135131
22	0 803396	0 646839	0 521893	0 421955	0·341850	0 277505	0·225713	0 183941	0 150182	0 122846
23	0·795442	0 634156	0·506692	0·405726	0·325571	0 261797	0·210947	0·170315	0·137781	0 111678
24	0·787566	0·621721	0·491934	0·390121	0·310068	0·246979	0·197147	0·157699	0·126405	0·101526
25	0·779768	0·609531	0·477606	0·375117	0·295303	0·232999	0·184249	0·146018	0·115968	0·092296
26	0·772048	0·597579	0·463695	0·360689	0·281241	0·219810	0·172195	0·135202	0·106393	0 083905
27	0 764404	0·585862	0·450189	0·346817	0·267848	0·207368	0·160930	0·125187	0·097608	0·076278
28	0·756836	0·574375	0·437077	0·333477	0·255094	0·195630	0·150402	0·115914	0·089548	0 069343
29	0·749342	0·563112	0·424346	0 320651	0·242946	0 184557	0·140563	0·107328	0 082155	0 063039
30	0·741923	0·552071	0·411987	0·308319	0·231377	0·174110	0·131367	0·099377	0·075371	0 057309
31	0·734577	0·541246	0 399987	0·296460	0·220359	0·164255	0·122773	0·092016	0·069148	0·052099
32	0·727304	0·530633	0 388337	0·285058	0·209866	0·154957	0·114741	0·085200	0·063438	0·047362
33	0·720103	0 520229	0·377026	0·274094	0·199873	0·146186	0·107235	0·078889	0·058200	0·043057
34	0·712973	0·510028	0·366045	0·263552	0·190355	0·137912	0·100219	0·073045	0·053395	0 039143
35	0·705914	0 500028	0 355383	0·253415	0·181290	0·130105	0·093663	0·067635	0·048986	0·035584
36	0 698925	0 490223	0·345032	0·243669	0·172657	0·122741	0·087535	0·062625	0·044941	0·032349
37	0·692005	0·480611	0·334983	0·234297	0·164436	0·115793	0·081809	0·057986	0·041231	0·029408
38	0 685153	0·471187	0·325226	0·225285	0·156605	0·109239	0·076457	0·053690	0·037826	0·026735
39	0·678370	0·461948	0·315754	0·216621	0·149148	0·103056	0·071455	0·049713	0·034703	0 024304
40	0·671653	0·452890	0·306557	0 208289	0·142046	0·097222	0·066780	0·046031	0·031838	0·022095
41	0·665003	0·444010	0·297628	0·200278	0·135282	0·091719	0·062412	0·042621	0·029209	0·020086
42	0·658419	0·435304	0·288959	0·192575	0·128840	0 086527	0·058329	0 039464	0 026797	0 018260
43	0·651900	0 426769	0 280543	0·185168	0·122704	0·081630	0·054513	0·036541	0 024584	0·016600
44	0·645445	0 418401	0·272372	0·178046	0·116861	0·077009	0·050946	0·033834	0·022555	0 015091
45	0·639055	0·410197	0 264439	0·171198	0·111297	0·072650	0·047613	0·031328	0·020692	0 013719
46	0·632728	0 402154	0·256737	0·164614	0·105997	0·068538	0 044499	0·029007	0·018984	0 012472
47	0·626463	0·394268	0·249259	0·158283	0·100949	0·064658	0·041587	0 026859	0 017416	0 011338
48	0 620260	0 386538	0 241999	0·152195	0·096142	0·060998	0·038867	0·024869	0 015978	0 010307
49	0·614119	0 378958	0·234950	0·146341	0·091564	0 057546	0 036324	0 023027	0 014659	0 009370
50	0 608039	0 371528	0·228107	0 140713	0·087204	0·054288	0·033948	0·021321	0 013449	0 008519

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table A $v_{n,r} = (1+r)^{-n}$ (continued)

Year	Percentage									
	11	12	13	14	15	16	17	18	19	20
1	0 900901	0 892857	0·884956	0 877193	0·869565	0·862069	0·854701	0·847458	0 840336	0·833333
2	0·811622	0·797194	0·783147	0·769468	0·756144	0·743163	0·730514	0·718184	0·706165	0·694444
3	0 731191	0·711780	0·693050	0·674972	0·657516	0·640658	0·624371	0·608631	0·593416	0·578704
4	0 658731	0·635518	0·613319	0·592080	0·571753	0·552291	0·533650	0·515789	0·498669	0·482253
5	0·593451	0·567427	0·542760	0·519369	0·497177	0·476113	0·456111	0·437109	0·419049	0·401878
6	0·534641	0·506631	0·480319	0·455587	0·432328	0·410442	0·389839	0·370432	0·352142	0·334898
7	0·481658	0·452349	0·425061	0·399637	0·375937	0·353830	0·333195	0·313925	0·295918	0·279082
8	0·433926	0·403883	0·376160	0·350559	0·326902	0·305025	0·284782	0·266038	0·248671	0·232568
9	0·390925	0·360610	0·332885	0·307508	0·284262	0·262953	0·243404	0·225456	0·208967	0·193807
10	0·352184	0·321973	0·294588	0·269744	0·247185	0·226684	0·208037	0·191064	0·175602	0·161506
11	0·317283	0·287476	0·260698	0·236617	0·214943	0·195417	0·177810	0·161919	0·147565	0·134588
12	0·285841	0·256675	0·230706	0·207559	0·186907	0·168463	0·151974	0·137220	0·124004	0·112157
13	0·257514	0·229174	0·204165	0 182069	0·162528	0·145227	0·129892	0·116288	0·104205	0·093464
14	0·231995	0·204620	0·180677	0·159710	0·141329	0·125195	0·111019	0·098549	0·087567	0·077887
15	0·209004	0·182696	0·159891	0·140096	0·122894	0·107927	0·094888	0·083516	0·073586	0·064905
16	0·188292	0·163122	0·141496	0·122892	0·106865	0·093041	0·081101	0·070776	0·061837	0·054088
17	0·169633	0·145644	0·125218	0·107800	0·092926	0·080207	0·069347	0·059980	0·051964	0·045073
18	0·152822	0·130040	0·110812	0·094561	0·080805	0·069144	0·059245	0·050830	0·043667	0·037561
19	0·137678	0·116107	0·098064	0·082948	0·070265	0·059607	0·050637	0·043077	0·036695	0·031301
20	0·124034	0·103667	0·086782	0·072762	0 061100	0·051385	0·043280	0·036506	0·030836	0 026084
21	0·111742	0 092560	0·076798	0·063826	0·053131	0 044298	0 036991	0 030937	0·025913	0 021737
22	0 100669	0 082643	0·067963	0·055988	0·046201	0·038188	0 031616	0 026218	0 021775	0 018114
23	0·090693	0·073788	0·060144	0·049112	0·040174	0·032920	0·027022	0·022219	0·018299	0·015095
24	0·081705	0·065882	0·053225	0·043081	0·034934	0·028380	0·023096	0·018829	0·015377	0 012579
25	0·073608	0·058823	0·047102	0·037790	0·030378	0·024465	0·019740	0·015957	0·012922	0·010483
26	0·066314	0·052521	0·041683	0·033149	0·026415	0·021094	0·016872	0·013523	0·010859	0·008735
27	0·059742	0·046894	0·036888	0·029078	0·022970	0·018182	0·014481	0·011460	0·009125	0·007280
28	0·053822	0·041869	0·032644	0·025587	0·019974	0·015674	0·012225	0·009712	0·007668	0·006066
29	0·048488	0·037383	0·028889	0·022375	0·017369	0·013512	0·010524	0·008230	0·006444	0·005055
30	0·043683	0·033378	0·025565	0·019627	0·015103	0·011648	0·009004	0·006975	0·005415	0·004213
31	0·039354	0·029802	0·022624	0·017217	0·013133	0·010042	0·007696	0·005911	0·004550	0·003511
32	0·035454	0·026609	0·020021	0·015102	0·011420	0·008657	0·006577	0·005009	0·003824	0·002926
33	0·031940	0·023758	0·017718	0·013248	0·009931	0·007463	0·005622	0·004245	0·003213	0·002438
34	0·028775	0·021212	0·015680	0·011621	0·008635	0·006493	0·004805	0·003598	0·002700	0·002032
35	0·025924	0·018940	0·013876	0·010194	0·007509	0·005546	0·004107	0·003049	0·002269	0·001693
36	0·023355	0·016910	0·012279	0·008942	0·006529	0·004781	0·003510	0·002584	0·001907	0·001411
37	0·021040	0·015098	0·010867	0·007844	0·005678	0·004124	0·003000	0·002190	0·001602	0·001176
38	0·018955	0·013481	0·009617	0·006880	0·004937	0·003555	0·002564	0·001856	0·001347	0·000980
39	0 017077	0·012036	0·008510	0·006035	0·004293	0·003065	0·002192	0·001573	0·001132	0·000816
40	0·015384	0·010747	0·007531	0·005294	0·003733	0·002640	0·001873	0·001333	0·000951	0·000680
41	0·013860	0·009595	0·006665	0·004644	0·003246	0·002276	0·001601	0·001129	0·000799	0·000576
42	0·012486	0·008567	0·005898	0·004074	0·002823	0·001962	0·001368	0·000957	0·000671	0·000472
43	0·011249	0·007649	0·005219	0·003573	0·002455	0·001692	0·001170	0·000811	0·000564	0·000394
44	0·010134	0·006830	0·004619	0·003135	0·002134	0·001458	0·001000	0·000687	0·000474	0·000328
45	0·009130	0·006098	0·004088	0·002750	0·001856	0·001257	0·000854	0·000583	0·000398	0·000273
46	0·008225	0·005445	0·003617	0·002412	0·001614	0·001084	0·000730	0·000494	0·000335	0·000228
47	0·007410	0·004861	0·003201	0·002116	0·001403	0·000934	0·000624	0·000418	0·000281	0·000190
48	0·006676	0·004340	0·002833	0·001856	0·001220	0·000805	0·000533	0·000355	0·000236	0·000158
49	0·006014	0·003875	0·002507	0·001628	0·001061	0·000694	0·000456	0·000300	0·000199	0·000132
50	0·005418	0·003460	0·002219	0·001428	0·000923	0·000599	0·000390	0·000255	0·000167	0·000110

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table A $v_{n,r} = (1+r)^{-n}$ (continued)

Year	Percentage									
	21	22	23	24	25	26	27	28	29	30
1	0·826446	0·819672	0·813008	0·806452	0·800000	0·793651	0·787402	0·781250	0·775194	0·769231
2	0·683013	0·671862	0·660982	0·650364	0·640000	0·629882	0·620001	0·610352	0·600925	0·591716
3	0·564474	0·550707	0·537384	0·524487	0·512000	0·499906	0·488190	0·476837	0·465834	0·455166
4	0·466507	0·451399	0·436897	0·422974	0·409600	0·396751	0·384402	0·372529	0·361111	0·350128
5	0·385543	0·369999	0·355201	0·341108	0·327680	0·314882	0·302678	0·291038	0·279931	0·269329
6	0·318631	0·303278	0·288781	0·275087	0·262144	0·249906	0·238329	0·227374	0·217001	0·207176
7	0·263331	0·248589	0·234782	0·221844	0·209715	0·198338	0·187661	0·177636	0·168218	0·159366
8	0·217629	0·203761	0·190879	0·178907	0·167772	0·157411	0·147765	0·138778	0·130401	0·122589
9	0·179859	0·167017	0·155187	0·144280	0·134218	0·124930	0·116350	0·108420	0·101085	0·094300
10	0·148644	0·136899	0·126168	0·116354	0·107374	0·099150	0·091614	0·084703	0·078362	0·072538
11	0·122846	0·112213	0·102576	0·093834	0·085899	0·078691	0·072137	0·066174	0·060745	0·055799
12	0·101526	0·091978	0·083395	0·075673	0·068719	0·062453	0·056801	0·051699	0·047089	0·042922
13	0·083905	0·075391	0·067801	0·061026	0·054976	0·049566	0·044725	0·040390	0·036503	0·033017
14	0·069343	0·061796	0·055122	0·049215	0·043980	0·039338	0·035217	0·031554	0·028297	0·025398
15	0·057309	0·050653	0·044815	0·039689	0·035184	0·031221	0·027730	0·024652	0·021936	0·019537
16	0·047362	0·041519	0·036435	0·032008	0·028147	0·024778	0·021834	0·019259	0·017005	0·015028
17	0·039143	0·034032	0·029622	0·025813	0·022518	0·019665	0·017192	0·015046	0·013182	0·011560
18	0·032349	0·027895	0·024083	0·020817	0·018014	0·015607	0·013537	0·011755	0·010218	0·008892
19	0·026735	0·022865	0·019580	0·016788	0·014412	0·012387	0·010659	0·009184	0·007921	0·006840
20	0·022095	0·018741	0·015918	0·013538	0·011529	0·009831	0·008393	0·007175	0·006141	0·005262
21	0·018260	0·015362	0·012942	0·010918	0·009223	0·007802	0·006609	0·005605	0·004760	0·004048
22	0·015091	0·012592	0·010522	0·008805	0·007379	0·006192	0·005204	0·004379	0·003690	0·003113
23	0·012472	0·010321	0·008554	0·007101	0·005903	0·004914	0·004097	0·003421	0·002860	0·002395
24	0·010307	0·008460	0·006955	0·005726	0·004722	0·003900	0·003226	0·002673	0·002217	0·001842
25	0·008519	0·006934	0·005654	0·004618	0·003778	0·003096	0·002540	0·002088	0·001719	0·001417
26	0·007040	0·005684	0·004597	0·003724	0·003022	0·002457	0·002000	0·001631	0·001331	0·001090
27	0·005818	0·004659	0·003737	0·003003	0·002418	0·001950	0·001575	0·001274	0·001031	0·000839
28	0·004809	0·003819	0·003038	0·002422	0·001934	0·001547	0·001240	0·000996	0·000801	0·000645
29	0·003974	0·003130	0·002470	0·001953	0·001547	0·001228	0·000977	0·000778	0·000621	0·000496
30	0·003284	0·002566	0·002008	0·001575	0·001238	0·000975	0·000769	0·000608	0·000481	0·000382
31	0·002714	0·002103	0·001633	0·001270	0·000990	0·000774	0·000605	0·000475	0·000373	0·000294
32	0·002243	0·001724	0·001328	0·001024	0·000792	0·000614	0·000477	0·000371	0·000289	0·000226
33	0·001854	0·001413	0·001079	0·000826	0·000634	0·000487	0·000375	0·000290	0·000224	0·000174
34	0·001532	0·001158	0·000877	0·000666	0·000507	0·000387	0·000296	0·000226	0·000174	0·000134
35	0·001266	0·000949	0·000713	0·000537	0·000406	0·000307	0·000233	0·000177	0·000135	0·000103
36	0·001046	0·000778	0·000580	0·000433	0·000325	0·000244	0·000183	0·000138	0·000104	0·791 4*
37	0·000865	0·000638	0·000472	0·000349	0·000260	0·000193	0·000144	0·000108	0·809 4*	0·608 4
38	0·000715	0·000523	0·000383	0·000282	0·000208	0·000153	0·000114	0·843 4*	0·627 4	0·468 4
39	0·000591	0·000429	0·000312	0·000227	0·000166	0·000122	0·895 4*	0·659 4	0·486 4	0·360 4
40	0·000488	0·000351	0·000253	0·000183	0·000133	0·966 4*	0·704 4	0·515 4	0·377 4	0·277 4
41	0·000403	0·000288	0·000206	0·000148	0·000106	0·767 4	0·555 4	0·402 4	0·292 4	0·213 4
42	0·000333	0·000236	0·000167	0·000119	0·851 4*	0·609 4	0·437 4	0·314 4	0·227 4	0·164 4
43	0·000276	0·000193	0·000136	0·961 4*	0·681 4	0·483 4	0·344 4	0·245 4	0·176 4	0·126 4
44	0·000228	0·000159	0·000111	0·775 4	0·544 4	0·383 4	0·271 4	0·192 4	0·136 4	0·969 5
45	0·000188	0·000130	0·900 4*	0·625 4	0·436 4	0·304 4	0·213 4	0·150 4	0·106 4	0·746 5
46	0·000156	0·000107	0·732 4	0·504 4	0·348 4	0·242 4	0·168 4	0·117 4	0·818 5	0·574 5
47	0·000129	0·873 4*	0·595 4	0·407 4	0·279 4	0·192 4	0·132 4	0·914 5	0·634 5	0·441 5
48	0·000106	0·716 4	0·484 4	0·328 4	0·223 4	0·152 4	0·104 4	0·714 5	0·492 5	0·339 5
49	0·878 4*	0·587 4	0·393 4	0·264 4	0·178 4	0·121 4	0·820 5	0·558 5	0·381 5	0·261 5
50	0·726 4	0·481 4	0·320 4	0·213 4	0·143 4	0·958 5	0·645 5	0·436 5	0·295 5	0·201 5

* The final digit is the power of 10 by which the given tabular value has to be divided.

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table A $v_{n,r} = (1+r)^{-n}$ (continued)

Year	Percentage									
	31	32	33	34	35	36	37	38	39	40
1	0 763359	0·757576	0 751880	0·746269	0·740741	0·735294	0 729927	0·724638	0·719424	0·714286
2	0·582717	0·573921	0·565323	0·556917	0·548697	0·540657	0·532793	0·525100	0·517572	0·510204
3	0·444822	0·434789	0·425055	0·415610	0·406442	0·397542	0·388900	0·380507	0 372354	0·364431
4	0·339559	0·329385	0·319590	0·310156	0·301068	0·292310	0·283869	0·275730	0·267880	0·260308
5	0·259205	0·249534	0·240293	0·231460	0·223014	0·214934	0·207204	0·199804	0·192720	0·185934
6	0·197866	0·189041	0·180672	0·172731	0·165195	0·158040	0·151243	0·144786	0·138647	0·132810
7	0·151043	0·143213	0·135843	0·128904	0·122367	0·116206	0·110397	0·104917	0·099746	0·094865
8	0·115300	0·108495	0·102138	0·096197	0·090642	0·085445	0·080582	0·076027	0·071760	0 067760
9	0·088015	0·082193	0·076795	0·071789	0·067142	0·062828	0·058819	0·055092	0·051626	0·048400
10	0·067187	0·062267	0·057741	0·053574	0·049735	0·046197	0·042933	0·039922	0 037141	0·034572
11	0·051288	0 047172	0·043414	0·039980	0·036841	0·033968	0·031338	0·028929	0·026720	0·024694
12	0·039151	0·035737	0·032642	0·029836	0·027289	0·024977	0·022875	0·020963	0·019223	0·017639
13	0·029886	0·027073	0·024543	0·022266	0·020214	0·018365	0·016697	0·015190	0·013830	0·012599
14	0·022814	0·020510	0·018453	0·016616	0·014974	0·013504	0·012187	0·011008	0·009949	0·008999
15	0·017415	0·015538	0·013875	0·012400	0·011092	0·009929	0·008896	0·007977	0·007158	0·006428
16	0·013294	0·011771	0·010432	0·009254	0·008216	0·007301	0·006493	0·005780	0·005149	0·004591
17	0·010148	0·008918	0·007844	0·006906	0·006086	0·005368	0·004740	0·004188	0·003705	0·003280
18	0·007747	0·006756	0·005898	0·005154	0·004508	0·003947	0·003460	0·003035	0·002665	0·002343
19	0·005914	0·005118	0·004434	0·003846	0·003339	0·002902	0·002525	0·002199	0·001917	0·001673
20	0·004514	0·003877	0·003334	0·002870	0·002474	0·002134	0·001843	0·001594	0·001379	0·001195
21	0·003446	0·002937	0·002507	0·002142	0·001832	0·001569	0·001345	0·001155	0·000992	0·000854
22	0·002630	0·002225	0·001885	0·001598	0·001357	0·001154	0·000982	0·000837	0·000714	0·000610
23	0·002008	0·001686	0 001417	0 001193	0·001005	0·000848	0·000717	0·000606	0·000514	0 000436
24	0·001533	0·001277	0·001066	0·000890	0·000745	0 000624	0·000523	0·000439	0·000370	0·000311
25	0·001170	0·000968	0·000801	0·000664	0·000552	0·000459	0·000382	0·000318	0·000266	0·000222
26	0·000893	0·000733	0·000602	0·000496	0·000409	0·000337	0·000279	0·000231	0·000191	0·000159
27	0·000682	0·000555	0·000453	0·000370	0·000303	0·000248	0·000203	0·000167	0·000138	0·000113
28	0·000520	0·000421	0·000341	0·000276	0·000224	0·000182	0·000149	0·000121	0·990 4*	0·810 4*
29	0·000397	0·000319	0·000256	0·000206	0·000166	0·000134	0·000108	0·878 4*	0·712 4	0·578 4
30	0·000303	0·000241	0·000193	0·000154	0·000123	0·986 4*	0·791 4*	0·636 4	0·512 4	0·413 4
31	0·000232	0·000183	0·000145	0·000115	0·911 4*	0·725 4	0·578 4	0·461 4	0·369 4	0·295 4
32	0·000177	0·000139	0·000109	0·856 4*	0·675 4	0·533 4	0·422 4	0·334 4	0·265 4	0·211 4
33	0·000135	0·000105	0·818 4*	0·639 4*	0.500 4	0·392 4	0·308 4	0·242 4	0·191 4	0·151 4
34	0·000103	0·795 4*	0·615 4	0·477 4	0·370 4	0·288 4	0·225 4	0·175 4	0·137 4	0·108 4
35	0·786 4*	0·602 4	0·463 4	0·356 4	0·274 4	0·212 4	0·164 4	0·127 4	0·987 5	0·768 5
36	0·600 4	0·456 4	0·348 4	0·266 4	0·203 4	0·156 4	0·120 4	0·921 5	0·710 5	0·549 5
37	0·458 4	0·346 4	0·262 4	0·198 4	0·151 4	0·115 4	0·874 5	0·668 5	0·511 5	0·392 5
38	0·350 4	0·262 4	0·197 4	0·148 4	0·112 4	0·842 5	0·638 5	0·484 5	0·368 5	0·280 5
39	0·267 4	0·198 4	0·148 4	0·110 4	0·826 5	0·619 5	0·465 5	0·351 5	0·264 5	0·200 5
40	0·204 4	0·150 4	0·111 4	0·824 5	0·612 5	0·455 5	0·340 5	0·254 5	0·190 5	0·143 5
41	0·156 4	0·114 4	0·836 5	0·615 5	0·453 5	0·335 5	0·248 5	0·184 5	0·137 5	0·102 5
42	0·119 4	0 863 5	0·628 5	0·459 5	0·336 5	0·246 5	0·181 5	0·133 5	0·985 6	0·729 6
43	0·906 5	0·654 5	0·472 5	0·342 5	0·249 5	0·181 5	0·132 5	0·966 6	0·709 6	0 521 6
44	0·692 5	0·495 5	0·355 5	0·255 5	0·184 5	0·133 5	0 964 6	0·700 6	0·510 6	0·372 6
45	0·528 5	0·375 5	0·267 5	0·191 5	0·136 5	0·979 6	0·704 6	0·508 6	0·367 6	0·266 6
46	0·403 5	0·284 5	0·201 5	0·142 5	0·101 5	0·720 6	0·514 6	0·368 6	0·264 6	0·190 6
47	0·308 5	0·215 5	0·151 5	0·106 5	0·749 6	0·529 6	0·375 6	0·266 6	0·190 6	0·136 6
48	0·235 5	0·163 5	0·114 5	0·792 6	0·555 6	0·389 6	0·274 6	0·193 6	0·137 6	0·968 7
49	0·179 5	0·124 5	0·854 6	0·591 6	0·411 6	0·286 6	0·200 6	0·140 6	0·982 7	0·691 7
50	0·137 5	0·936 6	0·642 6	0·441 6	0·304 6	0·210 6	0·146 6	0·101 6	0·707 7	0·494 7

* The final digit is the power of 10 by which the given tabular value has to be divided.

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table A $v_{n|r} = (1+r)^{-n}$ (continued)

Year	Percentage 41	42	43	44	45	46	47	48	49	50
1	0·709220	0·704225	0·699301	0·694444	0·689655	0·684932	0·680272	0·675676	0·671141	0·666667
2	0·502993	0·495933	0·489021	0·482253	0·475624	0·469131	0·462770	0·456538	0·450430	0·444444
3	0·356732	0·349249	0·341973	0·334898	0·328017	0·321323	0·314810	0·308471	0·302302	0·296296
4	0·253002	0·245950	0·239142	0·232568	0·226218	0·220084	0·214156	0·208427	0·202887	0·197531
5	0·179434	0·173204	0·167232	0·161506	0·156013	0·150743	0·145684	0·140829	0·136166	0·131687
6	0·127258	0·121975	0·116946	0·112157	0·107595	0·103248	0·099105	0·095155	0·091387	0·087791
7	0·090254	0·085898	0·081780	0·077887	0·074203	0·070718	0·067418	0·064294	0·061333	0·058528
8	0·064010	0·060491	0·057189	0·054088	0·051175	0·048437	0·045863	0·043442	0·041163	0·039018
9	0·045397	0·042600	0·039992	0·037561	0·035293	0·033176	0·031199	0·029352	0·027626	0·026012
10	0·032197	0·030000	0·027967	0·026084	0·024340	0·022723	0·021224	0·019833	0·018541	0·017342
11	0·022834	0·021127	0·019557	0·018114	0·016786	0·015564	0·014438	0·013401	0·012444	0·011561
12	0·016195	0·014878	0·013676	0·012579	0·011577	0·010660	0·009822	0·009054	0·008352	0·007707
13	0·011486	0·010477	0·009564	0·008735	0·007984	0·007302	0·006682	0·006118	0·005605	0·005138
14	0·008146	0·007378	0·006688	0·006066	0·005506	0·005001	0·004545	0·004134	0·003762	0·003425
15	0·005777	0·005196	0·004677	0·004213	0·003797	0·003425	0·003092	0·002793	0·002525	0·002284
16	0·004097	0·003659	0·003271	0·002926	0·002619	0·002346	0·002103	0·001887	0·001694	0·001522
17	0·002906	0·002577	0·002287	0·002032	0·001806	0·001607	0·001431	0·001275	0·001137	0·001015
18	0·002061	0·001815	0·001599	0·001411	0·001246	0·001101	0·000973	0·000862	0·000763	0·000677
19	0·001462	0·001278	0·001118	0·000980	0·000859	0·000754	0·000662	0·000582	0·000512	0·000451
20	0·001037	0·000900	0·000782	0·000680	0·000592	0·000516	0·000450	0·000393	0·000344	0·000301
21	0·000735	0·000634	0·000547	0·000472	0·000409	0·000354	0·000306	0·000266	0·000231	0·000200
22	0·000521	0·000446	0·000382	0·000328	0·000282	0·000242	0·000208	0·000180	0·000155	0·000134
23	0·000370	0·000314	0·000267	0·000228	0·000194	0·000166	0·000142	0·000121	0·000104	0·891 4*
24	0·000262	0·000221	0·000187	0·000158	0·000134	0·000114	0·965 4*	0·820 4*	0·697 4*	0·594 4
25	0·000186	0·000156	0·000131	0·000110	0·924 4*	0·778 4*	0·656 4	0·554 4	0·468 4	0·396 4
26	0·000132	0·000110	0·915 4*	0·763 4*	0·637 4	0·533 4	0·446 4	0·374 4	0·314 4	0·264 4
27	0·936 4*	0·773 4*	0·640 4	0·530 4	0·440 4	0·365 4	0·304 4	0·253 4	0·211 4	0·176 4
28	0·664 4	0·544 4	0·447 4	0·368 4	0·303 4	0·250 4	0·207 4	0·171 4	0·142 4	0·117 4
29	0·471 4	0·383 4	0·313 4	0·256 4	0·209 4	0·171 4	0·141 4	0·115 4	0·950 5	0·782 5
30	0·334 4	0·270 4	0·219 4	0·177 4	0·144 4	0·117 4	0·956 5	0·780 5	0·637 5	0·522 5
31	0·237 4	0·190 4	0·153 4	0·123 4	0·994 5	0·804 5	0·650 5	0·527 5	0·428 5	0·348 5
32	0·168 4	0·134 4	0·107 4	0·856 5	0·686 5	0·550 5	0·442 5	0·356 5	0·287 5	0·232 5
33	0·119 4	0·943 5	0·748 5	0·594 5	0·473 5	0·377 5	0·301 5	0·241 5	0·193 5	0·155 5
34	0·844 5	0·664 5	0·523 5	0·413 5	0·326 5	0·258 5	0·205 5	0·163 5	0·129 5	0·103 5
35	0·599 5	0·468 5	0·366 5	0·287 5	0·225 5	0·177 5	0·139 5	0·110 5	0·868 6	0·687 6
36	0·425 5	0·329 5	0·256 5	0·199 5	0·155 5	0·121 5	0·947 6	0·742 6	0·582 6	0·458 6
37	0·301 5	0·232 5	0·179 5	0·138 5	0·107 5	0·830 6	0·645 6	0·502 6	0·391 6	0·305 6
38	0·214 5	0·163 5	0·125 5	0·960 6	0·738 6	0·568 6	0·438 6	0·339 6	0·262 6	0·203 6
39	0·152 5	0·115 5	0·875 6	0·667 6	0·509 6	0·389 6	0·298 6	0·229 6	0·176 6	0·136 6
40	0·107 5	0·810 6	0·612 6	0·463 6	0·351 6	0·267 6	0·203 6	0·155 6	0·118 6	0·904 7
41	0·762 6	0·570 6	0·428 6	0·321 6	0·242 6	0·183 6	0·138 6	0·105 6	0·793 7	0·603 7
42	0·541 6	0·402 6	0·299 6	0·223 6	0·167 6	0·125 6	0·939 7	0·706 7	0·532 7	0·402 7
43	0·383 6	0·283 6	0·209 6	0·155 6	0·115 6	0·857 7	0·639 7	0·477 7	0·357 7	0·268 7
44	0·272 6	0·199 6	0·146 6	0·108 6	0·794 7	0·587 7	0·435 7	0·322 7	0·240 7	0·179 7
45	0·193 6	0·140 6	0·102 6	0·748 7	0·548 7	0·402 7	0·296 7	0·218 7	0·161 7	0·119 7
46	0·137 6	0·988 7	0·715 7	0·519 7	0·378 7	0·275 7	0·201 7	0·147 7	0·108 7	0·794 8
47	0·970 7	0·696 7	0·500 7	0·361 7	0·260 7	0·189 7	0·137 7	0·995 8	0·725 8	0·529 8
48	0·688 7	0·490 7	0·350 7	0·250 7	0·180 7	0·129 7	0·931 8	0·672 8	0·486 8	0·353 8
49	0·488 7	0·345 7	0·245 7	0·174 7	0·124 7	0·885 8	0·633 8	0·454 8	0·326 8	0·235 8
50	0·346 7	0·243 7	0·171 7	0·121 7	0·854 8	0·606 8	0·431 8	0·307 8	0·219 8	0·157 8

* The final digit is the power of 10 by which the given tabular value has to be divided.

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table 8 $a_{n,r} = \frac{1-(1+r)^{-n}}{r}$

Year	Percentage									
	1	2	3	4	5	6	7	8	9	10
1	0·990099	0·980392	0·970874	0·961538	0·952381	0·943396	0·934579	0·925926	0·917431	0·909091
2	1·97040	1·94156	1·91347	1·88609	1·85941	1·83339	1·80802	1·78326	1·75911	1·73554
3	2·94099	2·88388	2·82861	2·77509	2·72325	2·67301	2·62432	2·57710	2·53129	2·48685
4	3·90197	3·80773	3·71710	3·62990	3·54595	3·46511	3·38721	3·31213	3·23972	3·16987
5	4·85343	4·71346	4·57971	4·45182	4·32948	4·21236	4·10020	3·99271	3·88965	3·79079
6	5·79548	5·60143	5·41719	5·24214	5·07569	4·91732	4·76654	4·62288	4·48592	4·35526
7	6·72819	6·47199	6·23028	6·00205	5·78637	5·58238	5·38929	5·20637	5·03295	4·86842
8	7·65168	7·32548	7·01969	6·73274	6·46321	6·20979	5·97130	5·74664	5·53482	5·33493
9	8·56602	8·16224	7·78611	7·43533	7·10782	6·80169	6·51523	6·24689	5·99525	5·75902
10	9·47130	8·98259	8·53020	8·11090	7·72173	7·36009	7·02358	6·71008	6·41766	6·14457
11	10·3676	9·78685	9·25262	8·76048	8·30641	7·88687	7·49867	7·13896	6·80519	6·49506
12	11·2551	10·5753	9·95400	9·38507	8·86325	8·38384	7·94269	7·53608	7·16073	6·81369
13	12·1337	11·3484	10·6350	9·98565	9·39357	8·85268	8·35765	7·90378	7·48690	7·10336
14	13·0037	12·1062	11·2961	10·5631	9·89864	9·29498	8·74547	8·24424	7·78615	7·36669
15	13·8651	12·8493	11·9379	11·1184	10·3797	9·71225	9·10791	8·55948	8·06069	7·60608
16	14·7179	13·5777	12·5611	11·6523	10·8378	10·1059	9·44665	8·85137	8·31256	7·82371
17	15·5623	14·2919	13·1661	12·1657	11·2741	10·4773	9·76322	9·12164	8·54363	8·02155
18	16·3983	14·9920	13·7535	12·6593	11·6896	10·8276	10·0591	9·37189	8·75563	8·20141
19	17·2260	15·6785	14·3238	13·1339	12·0853	11·1581	10·3356	9·60360	8·95011	8·36492
20	18·0456	16·3514	14·8775	13·5903	12·4622	11·4699	10·5940	9·81815	9·12855	8·51356
21	18·8570	17·0112	15·4150	14·0292	12·8212	11·7641	10·8355	10·0168	9·29224	8·64869
22	19·6604	17·6580	15·9369	14·4511	13·1630	12·0416	11·0612	10·2007	9·44243	8·77154
23	20·4558	18·2922	16·4436	14·8568	13·4886	12·3034	11·2722	10·3711	9·58021	8·88322
24	21·2434	18·9139	16·9355	15·2470	13·7986	12·5504	11·4693	10·5288	9·70661	8·98474
25	22·0232	19·5235	17·4131	15·6221	14·0939	12·7834	11·6536	10·6748	9·82258	9·07704
26	22·7952	20·1210	17·8768	15·9828	14·3752	13·0032	11·8258	10·8100	9·92897	9·16095
27	23·5596	20·7069	18·3270	16·3296	14·6430	13·2105	11·9867	10·9352	10·0266	9·23722
28	24·3164	21·2813	18·7641	16·6631	14·8981	13·4062	12·1371	11·0511	10·1161	9·30657
29	25·0658	21·8444	19·1885	16·9837	15·1411	13·5907	12·2777	11·1584	10·1983	9·36961
30	25·8077	22·3965	19·6004	17·2920	15·3725	13·7648	12·4090	11·2578	10·2737	9·42691
31	26·5423	22·9377	20·0004	17·5885	15·5928	13·9291	12·5318	11·3498	10·3428	9·47901
32	27·2696	23·4683	20·3888	17·8736	15·8027	14·0840	12·6466	11·4350	10·4062	9·52638
33	27·9897	23·9886	20·7658	18·1476	16·0025	14·2302	12·7538	11·5139	10·4644	9·56943
34	28·7027	24·4986	21·1318	18·4112	16·1929	14·3681	12·8540	11·5869	10·5178	9·60857
35	29·4086	24·9986	21·4872	18·6646	16·3742	14·4982	12·9477	11·6546	10·5668	9·64416
36	30·1075	25·4888	21·8323	18·9083	16·5469	14·6210	13·0352	11·7172	10·6118	9·67651
37	30·7995	25·9695	22·1672	19·1426	16·7113	14·7368	13·1170	11·7752	10·6530	9·70592
38	31·4847	26·4406	22·4925	19·3679	16·8679	14·8460	13·1935	11·8289	10·6908	9·73265
39	32·1630	26·9026	22·8082	19·5845	17·0170	14·9491	13·2649	11·8786	10·7255	9·75696
40	32·8347	27·3555	23·1148	19·7928	17·1591	15·0463	13·3317	11·9246	10·7574	9·77905
41	33·4997	27·7995	23·4124	19·9931	17·2944	15·1380	13·3941	11·9672	10·7866	9·79914
42	34·1581	28·2348	23·7014	20·1856	17·4232	15·2245	13·4524	12·0067	10·8134	9·81740
43	34·8100	28·6616	23·9819	20·3708	17·5459	15·3062	13·5070	12·0432	10·8380	9·83400
44	35·4555	29·0800	24·2543	20·5488	17·6628	15·3832	13·5579	12·0771	10·8605	9·84909
45	36·0945	29·4902	24·5187	20·7200	17·7741	15·4558	13·6055	12·1084	10·8812	9·86281
46	36·7272	29·8923	24·7754	20·8847	17·8801	15·5244	13·6500	12·1374	10·9002	9·87528
47	37·3537	30·2866	25·0247	21·0429	17·9810	15·5890	13·6916	12·1643	10·9176	9·88662
48	37·9740	30·6731	25·2667	21·1951	18·0772	15·6500	13·7305	12·1891	10·9336	9·89693
49	38·5881	31·0521	25·5017	21·3415	18·1687	15·7076	13·7668	12·2122	10·9482	9·90630
50	39·1961	31·4236	25·7298	21·4822	18·2559	15·7619	13·8007	12·2335	10·9617	9·91481

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table B $a_{n,r} = \frac{1-(1+r)^{-n}}{r}$ (continued)

Year	Percentage 11	12	13	14	15	16	17	18	19	20
1	0 900901	0·892857	0·884956	0·877193	0·869565	0·862069	0·854701	0·847458	0 840336	0 833333
2	1·71252	1·69005	1·66810	1·64666	1·62571	1·60523	1·58521	1·56564	1·54650	1·52778
3	2 44371	2·40183	2·36115	2·32163	2·28323	2·24589	2·20958	2·17427	2·13992	2 10648
4	3·10245	3·03735	2 97447	2·91371	2·85498	2·79818	2 74324	2·69006	2·63859	2 58873
5	3·69590	3·60478	3·51723	3·43308	3·35216	3·27429	3·19935	3·12717	3 05763	2 99061
6	4·23054	4·11141	3·99755	3·88867	3·78448	3·68474	3 58918	3·49760	3·40978	3·32551
7	4·71220	4·56376	4·42261	4·28830	4·16042	4·03857	3·92238	3·81153	3·70570	3·60459
8	5·14612	4·96764	4·79877	4·63886	4·48732	4·34359	4·20716	4·07757	3·95437	3·83716
9	5·53705	5·32825	5 13166	4·94637	4·77158	4·60654	4·45057	4·30302	4·16333	4·03097
10	5·88923	5·65022	5 42624	5.21612	5·01877	4·83323	4·65860	4·49409	4·33893	4·19247
11	6·20652	5·93770	5·68694	5·45273	5·23371	5·02864	4·83641	4·65601	4·48650	4·32706
12	6·49236	6·19437	5·91765	5·66029	5·42062	5·19711	4·98839	4·79322	4 61050	4·43922
13	6·74987	6·42355	6·12181	5·84236	5·58315	5·34233	5·11828	4·90951	4·71471	4·53268
14	6 98187	6·62817	6·30249	6·00207	5·72448	5·46753	5·22930	5·00806	4·80228	4·61057
15	7·19087	6·81086	6·46238	6·14217	5·84737	5·57546	5·32419	5·09158	4·87586	4·67547
16	7·37916	6·97399	6·60388	6·26506	5·95423	5·66850	5·40529	5·16235	4·93770	4·72956
17	7·54879	7·11963	6·72909	6·37286	6·04716	5·74870	5·47461	5·22233	4·98966	4·77463
18	7·70162	7·24967	6·83991	6·46742	6·12797	5·81785	5·53385	5·27316	5·03333	4·81219
19	7·83929	7·36578	6·93797	6·55037	6·19823	5·87746	5·58449	5·31624	5·07003	4·84350
20	7·96333	7·46944	7·02475	6·62313	6·25933	5·92884	5·62777	5·35275	5·10086	4·86958
21	8·07507	7·56200	7·10155	6·68696	6·31246	5·97314	5·66476	5·38368	5·12677	4·89132
22	8·17574	7·64465	7·16951	6·74294	6·35866	6·01133	5·69637	5·40990	5·14855	4·90943
23	8·26643	7·71843	7·22966	6·79206	6·39884	6·04425	5·72340	5·43212	5·16685	4·92453
24	8·34814	7·78432	7·28288	6·83514	6·43377	6·07263	5·74649	5·45095	5·18223	4·93710
25	8·42174	7·84314	7·32998	6·87293	6·46415	6·09709	5·76623	5·46691	5·19515	4·94759
26	8·48806	7·89566	7·37167	6·90608	6·49056	6·11818	5·78311	5·48043	5·20601	4·95632
27	8·54780	7·94255	7·40856	6·93515	6·51353	6·13636	5·79753	5·49189	5·21513	4·96360
28	8·60162	7·98442	7·44120	6·96066	6·53351	6·15204	5·80985	5·50160	5·22280	4·96967
29	8·65011	8·02181	7·47009	6·98304	6·55088	6·16555	5·82039	5·50983	5·22924	4·97472
30	8·69379	8·05518	7·49565	7·00266	6·56598	6·17720	5·82939	5·51681	5·23466	4·97894
31	8·73315	8·08499	7·51828	7·01988	6·57911	6·18724	5·83709	5·52272	5·23921	4·98245
32	8·76860	8·11159	7·53830	7·03498	6·59053	6·19590	5·84366	5·52773	5·24303	4·98537
33	8·80054	8·13535	7·55602	7·04823	6·60046	6·20336	5·84928	5·53197	5·24625	4·98781
34	8·82932	8·15656	7·57170	7·05985	6·60910	6·20979	5·85409	5·53557	5·24895	4·98984
35	8·85524	8·17550	7·58557	7·07005	6·61661	6·21534	5·85820	5·53862	5·25122	4·99154
36	8·87859	8·19241	7·59785	7·07899	6·62314	6·22012	5·86171	5·54120	5·25312	4·99295
37	8·89963	8·20751	7·60872	7·08683	6·62881	6·22424	5·86471	5·54339	5·25472	4·99412
38	8·91859	8·22099	7·61833	7·09371	6·63375	6·22779	5·86727	5·54525	5·25607	4·99510
39	8·93567	8·23303	7·62684	7·09975	6·63805	6·23086	5·86946	5·54682	5·25720	4·99592
40	8·95105	8·24378	7·63438	7·10504	6·64178	6·23350	5·87133	5·54815	5·25815	4·99660
41	8·96491	8·25337	7·64104	7·10969	6·64502	6·23577	5·87294	5·54928	5·25895	4·99717
42	8·97740	8·26194	7·64694	7·11376	6·64785	6·23774	5·87430	5·55024	5·25962	4·99764
43	8·98865	8·26959	7·65216	7·11733	6·65030	6·23943	5·87547	5·55105	5·26019	4·99803
44	8·99878	8·27642	7·65678	7·12047	6·65244	6·24089	5·87647	5·55174	5·26066	4·99836
45	9·00791	8·28252	7·66086	7·12322	6·65429	6·24214	5·87733	5·55232	5·26106	4·99863
46	9·01614	8·28796	7·66448	7·12563	6·65591	6·24323	5·87806	5·55281	5·26140	4·99886
47	9·02355	8·29282	7·66768	7·12774	6·65731	6·24416	5·87868	5·55323	5·26168	4·99905
48	9·03022	8·29716	7·67052	7·12960	6·65853	6·24497	5·87922	5·55359	5·26191	4·99921
49	9·03624	8·30104	7·67302	7·13123	6·65959	6·24566	5·87967	5·55389	5·26211	4·99934
50	9·04165	8·30450	7·67524	7·13266	6·66051	6·24626	5·88006	5·55414	5·26228	4·99945

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table B $a_{n,r} = \frac{1-(1+r)^{-n}}{r}$ (continued)

Year	Percentage									
	21	22	23	24	25	26	27	28	29	30
1	0·826446	0 819672	0·813008	0 806452	0·800000	0·793651	0·787402	0·781250	0·775194	0·769231
2	1·50946	1·49153	1·47399	1·45682	1·44000	1·42353	1·40740	1·39160	1·37612	1·36095
3	2·07393	2 04224	2·01137	1·98130	1·95200	1·92344	1·89559	1·86844	1·84195	1·81611
4	2·54044	2·49364	2·44827	2·40428	2·36160	2·32019	2·27999	2·24097	2·20306	2·16624
5	2·92598	2·86364	2·80347	2·74538	2·68928	2·63507	2·58267	2·53201	2·48300	2·43557
6	3·24462	3·16692	3·09225	3·02047	2·95142	2·88498	2·82100	2·75938	2·70000	2·64275
7	3·50795	3·41551	3·32704	3·24232	3·16114	3·08331	3·00866	2·93702	2·86821	2·80211
8	3·72558	3·61927	3·51792	3·42122	3·32891	3·24073	3·15643	3·07579	2·99862	2·92470
9	3·90543	3·78628	3·67310	3·56550	3·46313	3·36566	3·27278	3·18421	3·09970	3·01900
10	4·05408	3·92318	3·79927	3·68186	3·57050	3·46481	3·36439	3·26892	3·17806	3·09154
11	4·17692	4·03540	3·90185	3·77569	3·65640	3·54350	3·43653	3·33509	3·23881	3·14734
12	4·27845	4·12737	3·98524	3·85136	3·72512	3·60595	3·49333	3·38679	3·28590	3·19026
13	4·36235	4·20277	4·05304	3·91239	3·78010	3·65552	3·53806	3·42718	3·32240	3·22328
14	4·43170	4·26456	4·10816	3·96160	3·82408	3·69485	3·57327	3·45873	3·35070	3·24867
15	4 48901	4·31522	4·15298	4·00129	3·85926	3·72607	3·60100	3·48339	3·37264	3·26821
16	4·53637	4·35673	4·18941	4·03330	3·88741	3·75085	3·62284	3·50265	3·38964	3·28324
17	4·57551	4·39077	4·21904	4·05911	3·90993	3·77052	3·64003	3·51769	3·40282	3·29480
18	4·60786	4·41866	4·24312	4·07993	3·92794	3·78613	3·65357	3·52945	3·41304	3·30369
19	4·63460	4·44152	4·26270	4·09672	3·94235	3·79851	3·66422	3·53863	3·42096	3·31053
20	4·65669	4·46027	4·27862	4·11026	3·95388	3·80834	3·67262	3·54580	3·42710	3·31579
21	4·67495	4·47563	4·29156	4·12117	3·96311	3·81615	3·67923	3·55141	3·43186	3·31984
22	4·69004	4·48822	4·30208	4·12998	3·97049	3·82234	3·68443	3·55579	3·43555	3·32296
23	4·70251	4·49854	4·31063	4·13708	3·97639	3·82725	3·68853	3·55921	3·43841	3·32535
24	4·71282	4·50700	4·31759	4·14281	3·98111	3·83115	3·69175	3·56188	3·44063	3·32719
25	4·72134	4·51393	4·32324	4·14742	3·98489	3·83425	3·69429	3·56397	3·44235	3·32861
26	4·72838	4·51962	4·32784	4·15115	3·98791	3·83670	3·69630	3·56560	3·44368	3·32970
27	4·73420	4·52428	4·33158	4·15415	3·99033	3·83865	3·69787	3·56688	3·44471	3·33054
28	4·73901	4·52810	4·33462	4·15657	3·99226	3·84020	3·69911	3·56787	3·44551	3·33118
29	4·74298	4·53123	4·33709	4·15853	3·99381	3·84143	3·70009	3·56865	3·44614	3·33168
30	4·74627	4·53379	4·33909	4·16010	3·99505	3·84240	3·70086	3·56926	3·44662	3·33206
31	4·74898	4·53590	4·34073	4·16137	3·99604	3·84318	3·70146	3·56973	3·44699	3·33235
32	4·75122	4·53762	4·34205	4·16240	3·99683	3·84379	3·70194	3·57010	3·44728	3·33258
33	4·75308	4·53903	4·34313	4·16322	3·99746	3·84428	3·70231	3·57039	3·44750	3·33275
34	4·75461	4·54019	4·34401	4·16389	3·99797	3·84467	3·70261	3·57062	3·44768	3·33289
35	4·75588	4·54114	4·34472	4·16443	3·99838	3·84497	3·70284	3·57080	3·44781	3·33299
36	4·75692	4·54192	4·34530	4·16486	3·99870	3·84522	3·70302	3·57094	3·44792	3·33307
37	4·75779	4·54256	4·34578	4·16521	3·99896	3·84541	3·70317	3·57104	3·44800	3·33313
38	4·75850	5·54308	4·34616	4·16549	3·99917	3·84556	3·70328	3·57113	3·44806	3·33318
39	4·75909	4·54351	4·34647	4·16572	3·99934	3·84569	3·70337	3·57119	3·44811	3·33321
40	4·75958	4·54386	4·34672	4·16590	3·99947	3·84578	3·70344	3·57124	3·44815	3·33324
41	4·75998	4·54415	4·34693	4·16605	3·99957	3·84586	3·70350	3·57128	3·44818	3·33326
42	4·76032	4·54438	4·34710	4·16617	3·99966	3·84592	3·70354	3·57132	3·44820	3·33328
43	4·76059	4·54458	4·34723	4·16627	3·99973	3·84597	3·70358	3·57134	3·44822	3·33329
44	4·76082	4·54473	4·34734	4·16634	3·99978	3·84601	3·70360	3·57136	3·44823	3·33330
45	4·76101	4·54486	4·34743	4·16641	3·99983	3·84604	3·70362	3·57138	3·44824	3·33331
46	4·76116	4·54497	4·34751	4·16646	3·99986	3·84606	3·70364	3·57139	3·44825	3·33331
47	4·76129	5·54506	4·34757	4·16650	3·99989	3·84608	3·70365	3·57140	3·44825	3·33332
48	4·76140	4·54513	4·34762	4·16653	3·99991	3·84610	3·70367	3·57140	3·44826	3·33332
49	4·76149	4·54519	4·34766	4·16656	3·99993	3·84611	3·70367	3·57141	3·44826	3·33332
50	4·76156	4·54524	4·34769	4·16658	3·99994	3·84612	3·70368	3·57141	3·44827	3·33333

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table 8 $a_{n|r} = \frac{1-(1+r)^{-n}}{r}$ (continued)

Year	Percentage									
	31	32	33	34	35	36	37	38	39	40
1	0·763359	0·757576	0·751880	0·746269	0·740741	0·735294	0·729927	0·724638	0·719424	0·714286
2	1·34608	1·33150	1·31720	1·30319	1·28944	1·27595	1·26272	1·24974	1·23700	1·22449
3	1·79090	1·76629	1·74226	1·71880	1·69588	1·67349	1·65162	1·63024	1·60935	1·58892
4	2·13046	2·09567	2·06185	2·02895	1·99695	1·96580	1·93549	1·90597	1·87723	1·84923
5	2·38966	2·34521	2·30214	2·26041	2·21996	2·18074	2·14269	2·10578	2·06995	2·03516
6	2·58753	2·53425	2·48281	2·43314	2·38516	2·33878	2·29394	2·25056	2·20860	2·16797
7	2·73857	2·67746	2·61866	2·56205	2·50752	2·45498	2·40433	2·35548	2·30834	2·26284
8	2·85387	2·78595	2·72079	2·65824	2·59817	2·54043	2·48491	2·43151	2·38010	2·33060
9	2·94189	2·86815	2·79759	2·73003	2·66531	2·60326	2·54373	2·48660	2·43173	2·37900
10	3·00907	2·93041	2·85533	2·78361	2·71504	2·64945	2·58667	2·52652	2·46887	2·41357
11	3·06036	2·97759	2·89874	2·82359	2·75188	2·68342	2·61800	2·55545	2·49559	2·43826
12	3·09951	2·01332	2·93139	2·85342	2·77917	2·70840	2·64088	2·57641	2·51481	2·45590
13	3·12940	3·04040	2·95593	2·87569	2·79939	2·72676	2·65758	2·59160	2·52864	2·46850
14	3·15221	3·06091	2·97438	2·89231	2·81436	2·74027	2·66976	2·60261	2·53859	2·47750
15	3·16963	3·07644	2·98826	2·90471	2·82545	2·75020	2·67866	2·61059	2·54575	2·48393
16	3·18292	3·08822	2·99869	2·91396	2·83367	2·75750	2·68515	2·61637	2·55090	2·48852
17	3·19307	3·09713	3·00653	2·92087	2·83975	2·76287	2·68989	2·62056	2 55460	2·49180
18	3·20082	3·10389	3·01243	2·92602	2·84426	2·76681	2·69335	2·62359	2·55727	2·49414
19	3·20673	3·10901	3·01687	2·92986	2·84760	2·76972	2·69588	2·62579	2·55919	2·49582
20	3·21124	3·11288	3·02020	2·93273	2·85008	2·77185	2·69772	2·62738	2·56057	2·49701
21	3·21469	3·11582	3·02271	2·93488	2·85191	2·77342	2·69907	2·62854	2·56156	2·49787
22	3·21732	3·11805	3·02459	2·93648	2·85327	2·77457	2·70005	2·62938	2·56227	2·49848
23	3·21933	3·11973	3·02601	2·93767	2·85427	2·77542	2·70077	2·62998	2·56279	2·49891
24	3·22086	3·12101	3·02707	2·93856	2·85502	2·77604	2·70129	2·63042	2·56316	2·49922
25	3·22203	3·12198	3·02788	2·93922	2·85557	2·77650	2·70167	2·63074	2·56342	2·49944
26	3·22293	3·12271	3·02848	2·93972	2·85598	2·77684	2·70195	2·63097	2·56361	2·49960
27	3·22361	3·12326	3·02893	2·94009	2·85628	2·77709	2·70215	2·63114	2·56375	2·49972
28	3·22413	3·12369	3·02927	2·94036	2·85650	2·77727	2·70230	2·63126	2·56385	2·49980
29	3·22452	3·12400	3·02953	2·94057	2·85667	2·77741	2·70241	2·63135	2·56392	2·49986
30	3·22483	3·12425	3·02972	2·94072	2·85679	2·77750	2·70249	2·63141	2·56397	2·49990
31	3·22506	3·12443	3·02986	2·94084	2·85688	2·77758	2·70255	2·63146	2·56401	2·49993
32	3·22524	3·12457	3·02997	2·94092	2·85695	2·77763	2·70259	2·63149	2·56403	2·49995
33	3·22537	3·12467	3·03006	2·94099	2·85700	2·77767	2·70262	2·63152	2·56405	2·49996
34	3·22547	3·12475	3·03012	2·94104	2·85704	2·77770	2·70264	2·63153	2·56407	2·49997
35	3·22555	3·12481	3·03016	2·94107	2·85706	2·77772	2·70266	2·63155	2·56408	2·49998
36	3·22561	3·12486	3·03020	2·94110	2·85708	2·77773	2·70267	2·63155	2·56408	2·49999
37	3·22566	3·12489	3·03022	2·94112	2·85710	2·77775	2·70268	2·63156	2·56409	2·49999
38	3·22569	3·12492	3·03024	2·94113	2·85711	2·77775	2·70269	2·63157	2·56409	2·49999
39	3·22572	3·12494	3·03026	2·94114	2·85712	2·77776	2·70269	2·63157	2·56410	2·50000
40	3·22574	3·12495	3·03027	2·94115	2·85713	2·77777	2·70269	2·63157	2·56410	2·50000
41	3·22576	3·12496	3·03028	2·94116	2·85713	2·77777	2·70270	2·63157	2·56410	2·50000
42	3·22577	3·12497	3·03028	2·94116	2·85713	2·77777	2·70270	2·63158	2·56410	2·50000
43	3·22578	3·12498	3·03029	2·94117	2·85714	2·77777	2·70270	2·63158	2·56410	2·50000
44	3·22578	3·12498	3·03029	2·94117	2·85714	2·77777	2·70270	2·63158	2·56410	2·50000
45	3·22579	3·12499	3·03029	2·94117	2·85714	2·77778	2·70270	2·63158	2·56410	2·50000
46	3·22579	3·12499	3·03030	2·94117	2·85714	2·77778	2·70270	2·63158	2·56410	2·50000
47	3·22580	3·12499	3·03030	2·94117	2·85714	2·77778	2·70270	2·63158	2·56410	2·50000
48	3·22580	3·12499	3·03030	2·94117	2·85714	2·77778	2·70270	2·63158	2·56410	2·50000
49	3·22580	3·12500	3·03030	2·94117	2·85714	2·77778	2·70270	2·63158	2·56410	2·50000
50	3·22580	3·12500	3·03030	2·94118	2·85714	2·77778	2·70270	2·63158	2·56410	2·50000

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table B $a_{n|r} = \frac{1-(1+r)^{-n}}{r}$ (continued)

Year	Percentage 41	42	43	44	45	46	47	48	49	50
1	0·709220	0·704225	0·699301	0·694444	0·689655	0·684932	0·680272	0·675676	0·671141	0·666667
2	1·21221	1·20016	1·18832	1·17670	1·16528	1·15406	1·14304	1·13221	1·12157	1·11111
3	1·56895	1·54941	1·53030	1·51160	1·49330	1·47539	1·45785	1·44068	1·42387	1·40741
4	1·82195	1·79536	1·76944	1·74416	1·71951	1·69547	1·67201	1·64911	1·62676	1·60494
5	2·00138	1·96856	1·93667	1·90567	1·87553	1·84621	1·81769	1·78994	1·76293	1·73663
6	2·12864	2·09054	2·05361	2·01783	1·98312	1·94946	1·91680	1·88509	1·85431	1·82442
7	2·21889	2·17643	2·13540	2·09571	2·05733	2·02018	1·98422	1·94939	1·91565	1·88294
8	2·28290	2·23693	2·19258	2·14980	2·10850	2·06862	2·03008	1·99283	1·95681	1·92196
9	2·32830	2·27952	2·23258	2·18736	2·14379	2·10179	2·06128	2·02218	1·98444	1·94798
10	2·36050	2·30952	2·26054	2·21345	2·16813	2·12451	2·08250	2·04202	2·00298	1·96532
11	2·38333	2·33065	2·28010	2·23156	2·18492	2·14008	2·09694	2·05542	2·01542	1·97688
12	2·39953	2·34553	2·29378	2·24414	2·19650	2·15074	2·10676	2·06447	2·02377	1·98459
13	2·41101	2·35601	2·30334	2·25287	2·20448	2·15804	2·11344	2·07059	2·02938	1·98972
14	2·41916	2·36338	2·31003	2·25894	2·20999	2·16304	2·11799	2·07472	2·03314	1·99315
15	2·42493	2·36858	2·31470	2·26315	2·21378	2·16647	2·12108	2·07751	2·03566	1·99543
16	2·42903	2·37224	2·31798	2·26608	2·21640	2·16881	2·12318	2·07940	2·03736	1·99696
17	2·43194	2·37482	2·32026	2·26811	2·21821	2·17042	2·12462	2·08068	2·03850	1·99797
18	2·43400	2·37663	2·32186	2·26952	2·21945	2·17152	2·12559	2·08154	2·03926	1·99865
19	2·43546	2·37791	2·32298	2·27050	2·22031	2·17227	2·12625	2·08212	2·03977	1·99910
20	2·43650	2·37881	2·32376	2·27118	2·22091	2·17279	2·12670	2·08251	2·04011	1·99940
21	2·43723	2·37944	2·32431	2·27165	2·22131	2·17314	2·12701	2·08278	2·04035	1·99960
22	2·43775	2·37989	2·32469	2·27198	2·22160	2·17339	2·12722	2·08296	2·04050	1·99973
23	2·43812	2·38020	2·32496	2·27221	2·22179	2·17355	2·12736	2·08308	2·04060	1·99982
24	2·43838	2·38043	2·32515	2·27237	2·22192	2·17367	2·12745	2·08316	2·04067	1·99988
25	2·43857	2·38058	2·32528	2·27248	2·22202	2·17374	2·12752	2·08322	2·04072	1·99992
26	2·43870	2·38069	2·32537	2·27255	2·22208	2·17380	2·12756	2·08326	2·04075	1·99995
27	2·43880	2·38077	2·32543	2·27261	2·22212	2·17383	2·12759	2·08328	2·04077	1·99996
28	2·43886	2·38082	2·32548	2·27264	2·22215	2·17386	2·12762	2·08330	2·04079	1·99998
29	2·43891	2·38086	2·32551	2·27267	2·22218	2·17388	2·12763	2·08331	2·04080	1·99998
30	2·43894	2·38089	2·32553	2·27269	2·22219	2·17389	2·12764	2·08332	2·04080	1·99999
31	2·43897	2·38091	2·32555	2·27270	2·22220	2·17390	2·12765	2·08332	2·04081	1·99999
32	2·43898	2·38092	2·32556	2·27271	2·22221	2·17390	2·12765	2·08333	2·04081	2·00000
33	2·43900	2·38093	2·32556	2·27271	2·22221	2·17390	2·12765	2·08333	2·04081	2·00000
34	2·43900	2·38094	2·32557	2·27272	2·22221	2·17391	2·12766	2·08333	2·04081	2·00000
35	2·43901	2·38094	2·32557	2·27272	2·22222	2·17391	2·12766	2·08333	2·04081	2·00000
36	2·43901	2·38094	2·32558	2·27272	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
37	2·43902	2·38095	2·32558	2·27272	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
38	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
39	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
40	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
41	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
42	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
43	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
44	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
45	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
46	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
47	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
48	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
49	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000
50	2·43902	2·38095	2·32558	2·27273	2·22222	2·17391	2·12766	2·08333	2·04082	2·00000

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table C $s_{n|r} = \frac{(1+r)^n - 1}{r}$

Year	Percentage									
	1	2	3	4	5	6	7	8	9	10
1	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000
2	2·01000	2·02000	2·03000	2·04000	2·05000	2·06000	2·07000	2·08000	2·09000	2·10000
3	3·03010	3·06040	3·09090	3·12160	3·15250	3·18360	3·21490	3·24640	3·27810	3·31000
4	4·06040	4·12161	4·18363	4·24646	4·31012	4·37462	4·43994	4·50611	4·57313	4·64100
5	5·10101	5·20404	5·30914	5·41632	5·52563	5·63709	5·75074	5·86660	5·98471	6·10510
6	6·15202	6·30812	6·46841	6·63298	6·80191	6·97532	7·15329	7·33593	7·52333	7·71561
7	7·21354	7·43428	7·66246	7·89829	8·14201	8·39384	8·65402	8·92280	9·20043	9·48717
8	8·28567	8·58297	8·89234	9·21423	9·54911	9·89747	10·2598	10·6366	11·0285	11·4359
9	9·36853	9·75463	10·1591	10·5828	11·0266	11·4913	11·9780	12·4876	13·0210	13·5795
10	10·4622	10·9497	11·4639	12·0061	12·5779	13·1808	13·8164	14·4866	15·1929	15·9374
11	11·5668	12·1687	12·8078	13·4864	14·2068	14·9716	15·7836	16·6455	17·5603	18·5312
12	12·6825	13·4121	14·1920	15·0258	15·9171	16·8699	17·8885	18·9771	20·1407	21·3843
13	13·8093	14·6803	15·6178	16·6268	17·7130	18·8821	20·1406	21·4953	22·9534	24·5227
14	14·9474	15·9739	17·0863	18·2919	19·5986	21·0151	22·5505	24·2149	26·0192	27·9750
15	16·0969	17·2934	18·5989	20·0236	21·5786	23·2760	25·1290	27·1521	29·3609	31·7725
16	17·2579	18·6393	20·1569	21·8245	23·6575	25·6725	27·8881	30·3243	33·0034	35·9497
17	18·4304	20·0121	21·7616	23·6975	25·8404	28·2129	30·8402	33·7502	36·9737	40·5447
18	19·6147	21·4123	23·4144	25·6454	28·1324	30·9057	33·9990	37·4502	41·3013	45·5992
19	20·8109	22·8406	25·1169	27·6712	30·5390	33·7600	37·3790	41·4463	46·0185	51·1591
20	22·0190	24·2974	26·8704	29·7781	33·0660	36·7856	40·9955	45·7620	51·1601	57·2750
21	23·2392	25·7833	28·6765	31·9692	35·7193	39·9927	44·8652	50·4229	56·7645	64·0025
22	24·4716	27·2990	30·5368	34·2480	38·5052	43·3923	49·0057	55·4568	62·8733	71·4027
23	25·7163	28·8450	32·4529	36·6179	41·4305	46·9958	53·4361	60·8933	69·5319	79·5430
24	26·9735	30·4219	34·4265	39·0826	44·5020	50·8156	58·1767	66·7648	76·7898	88·4973
25	28·2432	32·0303	36·4593	41·6459	47·7271	54·8645	63·2490	73·1059	84·7009	98·3471
26	29·5256	33·6709	38·5530	44·3117	51·1135	59·1564	68·6765	79·9544	93·3240	109·182
27	30·8209	35·3443	40·7096	47·0842	54·6691	63·7058	74·4838	87·3508	102·723	121·100
28	32·1291	37·0512	42·9309	49·9676	58·4026	68·5281	80·6977	95·3388	112·968	134·210
29	33·4504	38·7922	45·2189	52·9663	62·3227	73·6398	87·3465	103·966	124·135	148·631
30	34·7849	40·5681	47·5754	56·0849	66·4388	79·0582	94·4608	113·283	136·308	164·494
31	36·1327	42·3794	50·0027	59·3283	70·7608	84·8017	102·073	123·346	149·575	181·943
32	37·4941	44·2270	52·5028	62·7015	75·2988	90·8898	110·218	134·214	164·037	201·138
33	38·8690	46·1116	55·0778	66·2095	80·0638	97·3432	118·933	145·951	179·800	222·252
34	40·2577	48·0338	57·7302	69·8579	85·0670	104·184	128·259	158·627	196·982	245·477
35	41·6603	49·9945	60·4621	73·6522	90·3203	111·435	138·237	172·317	215·711	271·024
36	43·0769	51·9944	63·2759	77·5983	95·8363	119·121	148·913	187·102	236·125	299·127
37	44·5076	54·0343	66·1742	81·7022	101·628	127·268	160·337	203·070	258·376	330·039
38	45·9527	56·1149	69·1594	85·9703	107·710	135 904	172·561	220·316	282·630	364 043
39	47·4123	58·2372	72·2342	90·4091	114·095	145 058	185·640	238·941	309 066	401·448
40	48·8864	60·4020	75·4013	95·0255	120·800	154·762	199·635	259·057	337·882	442·593
41	50·3752	62·6100	78·6633	99·8765	127·840	165·048	214·610	280·781	369·292	487·852
42	51·8790	64·8622	82·0232	104·820	135·232	175·951	230·632	304·244	403·528	537·637
43	53·3978	67·1595	85·4839	110·012	142·993	187·508	247·776	329·583	440·846	592·401
44	54·9318	69·5027	89·0484	115·413	151·143	199·758	266·121	356·950	481·522	652·641
45	56·4811	71·8927	92·7199	121·029	159·700	212·744	285·749	386·506	525·859	718·905
46	58·0459	74·3306	96·5015	126·871	168·685	226·508	306·752	418·426	574·186	791·795
47	59·6263	76·8172	100·397	132·945	178·119	241 099	329·224	452·900	626 863	871·975
48	61·2226	79·3535	104·408	139·263	188·025	256·565	353·270	490·132	684·280	960·172
49	62·8348	81·9406	108·541	145·834	198·427	272·958	378·999	530·343	746·866	1057·19
50	64·4632	84·5794	112·797	152·667	209·348	290·336	406·529	573·770	815·084	1163·91

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table C $s_{n,r} = \dfrac{(1+r)^n - 1}{r}$ (continued)

Year	Percentage									
	11	12	13	14	15	16	17	18	19	20
1	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000
2	2·11000	2·12000	2·13000	2·14000	2·15000	2·16000	2·17000	2·18000	2·19000	2·20000
3	3·34210	3·37440	3·40690	3·43960	3·47250	3·50560	3·53890	3·57240	3·60610	3·64000
4	4·70973	4·77933	4·84980	4·92114	4·99337	5·06650	5·14051	5·21543	5·29126	5 36800
5	6·22780	6·35285	6·48027	6·61010	6·74238	6·87714	7·01440	7·15421	7·29660	7·44160
6	7·91286	8·11519	8·32271	8·53552	8·75374	8·97748	9·20685	9·44197	9·68295	9·92992
7	9·78327	10·0890	10·4047	10·7305	11·0668	11·4139	11·7720	12·1415	12·5227	12·9159
8	11·8594	12·2997	12·7573	13·2328	13·7268	14·2401	14·7733	15·3270	15·9020	16·4991
9	14·1640	14·7757	15·4157	16·0853	16·7858	17·5185	18·2847	19·0859	19·9234	20·7989
10	16·7220	17·5487	18·4197	19·3373	20·3037	21·3215	22·3931	23·5213	24·7089	25·9587
11	19·5614	20·6546	21·8143	23·0445	24·3493	25·7329	27·1999	28·7551	30·4035	32·1504
12	22·7132	24·1331	25·6502	27·2707	29·0017	30·8502	32·8239	34·9311	37·1802	39·5805
13	26·2116	28·0291	29·9847	32·0887	34·3519	36·7862	39·4040	42·2187	45·2445	48·4966
14	30·0949	32·3926	34·8827	37·5811	40·5047	43·6720	47·1027	50·8180	54·8409	59·1959
15	34·4054	37·2797	40·4175	43·8424	47·5804	51·6595	56·1101	60·9653	66·2607	72·0351
16	39·1899	42·7533	46·6717	50·9804	55·7175	60·9250	66·6488	72·9390	79·8502	87·4421
17	44·5008	48·8837	53·7391	59·1176	65·0751	71·6730	78·9792	87·0680	96·0218	105·931
18	50·3959	55·7497	61·7251	68·3941	75·8364	84·1407	93·4056	103·740	115·266	128·117
19	56·9395	63·4397	70·7494	78·9692	88·2118	98·6032	110·285	123·414	138·166	154·740
20	64·2028	72·0524	80·9468	91·0249	102·444	115·380	130·033	146·628	165·418	186·688
21	72·2651	81·6987	92·4699	104·768	118·810	134·841	153·139	174·021	197·847	225·026
22	81·2143	92·5026	105·491	120·436	137·632	157·415	180·172	206·345	236·438	271·031
23	91·1479	104·603	120·205	138·297	159·276	183·601	211·801	244·487	282·362	326·237
24	102·174	118·155	136·831	158·659	184·168	213·978	248·808	289·494	337·010	392·484
25	114·413	133·334	155·620	181·871	212·793	249·214	292·105	342·603	402·042	471·981
26	127·999	150·334	176·850	208·333	245·712	290·088	342·763	405·272	479·431	567·377
27	143·079	169·374	200·841	238·499	283·569	337·502	402·032	479·221	571·522	681·853
28	159·817	190·699	227·950	272·889	327·104	392·503	471·378	566·481	681·112	819·223
29	178·397	214·583	258·583	312·094	377·170	456·303	552·512	669·447	811·523	984·068
30	199·021	241·333	293·199	356·787	434·745	530·312	647·439	790·948	966·712	1181·88
31	221·913	271·293	332·315	407·737	500·957	616·162	758·504	934·319	1151·39	1419·26
32	247·324	304·848	376·516	465·820	577·100	715·747	888·449	1103·50	1371·15	1704·11
33	275·529	342·429	426·463	532·035	664·666	831·267	1040·49	1303·13	1632·67	2045·93
34	306·837	384·521	482·903	607·520	765·365	965·270	1218·37	1538·69	1943·88	2456·12
35	341·590	431·663	546·681	693·573	881·170	1120·71	1426·49	1816·65	2314·21	2948·34
36	380·164	484·463	618·749	791·673	1014·35	1301·03	1669·99	2144·65	2754·91	3539·01
37	422·982	543·599	700·187	903·507	1167·50	1510·19	1954·89	2531·69	3279·35	4247·81
38	470·511	609·831	792·211	1031·00	1343·62	1752·82	2288·23	2988·39	3903·42	5098·37
39	523·267	684·010	896·198	1176·34	1546·17	2034·27	2678·22	3527·30	4646·07	6119·05
40	581·826	767·091	1013·70	1342·03	1779·09	2360·76	3134·52	4163·21	5529·83	7343·86
41	646·827	860·142	1146·49	1530·91	2046·95	2739·48	3668·39	4913·59	6581·50	8813·63
42	718·978	964·359	1296·53	1746·24	2355·00	3178·79	4293·02	5799·04	7832·98	10577·4
43	799·065	1081·08	1466 08	1991·71	2709·25	3688·40	5023·83	6843·86	9322·25	12693·8
44	887·963	1211·81	1657·67	2271·55	3116·63	4279·55	5878·88	8076·76	11094·5	15233·6
45	986·639	1358·23	1874·16	2590·56	3585·13	4965·27	6879·29	9531·58	13203·4	18281·3
46	1096·17	1522·22	2118·81	2954·24	4123·90	5760·72	8049·77	11248·3	15713·1	21938·6
47	1217·75	1705·88	2395·25	3368·84	4743·48	6683·43	9419·23	13273·9	18699·6	26327·3
48	1352·70	1911·59	2707·63	3841·48	5456·00	7753·78	11021·5	15664·3	22253·5	31593·7
49	1502·50	2141·98	3060·63	4380·28	6275·41	8995·39	12896·2	18484·8	26482·6	37913·5
50	1668·77	2400·02	3459·51	4994 52	7217·12	10435·6	15069·5	21813·1	31515·3	45497·2

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table C $s_{n,r} = \frac{(1+r)^n - 1}{r}$ (continued)

Year	Percentage									
	21	22	23	24	25	26	27	28	29	30
1	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000
2	2·21000	2·22000	2·23000	2·24000	2·25000	2·26000	2·27000	2·28000	2·29000	2·30000
3	3·67410	3·70840	3·74290	3·77760	3·81250	3·84760	3·88290	3·91840	3·95410	3·99000
4	5·44566	5·52425	5·60377	5·68422	5·76562	5·84798	5·93128	6·01555	6·10079	6·18700
5	7·58925	7·73958	7·89263	8·04844	8·20703	8·36845	8·53273	8·69991	8·87002	9·04310
6	10·1830	10·4423	10·7079	10·9801	11·2588	11·5442	11·8366	12·1359	12·4423	12·7560
7	13·3214	13·7396	14·1708	14·6153	15·0735	15·5458	16·0324	16·5339	17·0506	17·5828
8	17·1189	17·7623	18·4300	19·1229	19·8419	20·5876	21·3612	22·1634	22·9953	23·8577
9	21·7139	22·6700	23·6690	24·7125	25·8023	26·9404	28·1287	29·3692	30·6639	32·0150
10	27·2738	28·6574	30·1128	31·6434	33·2529	34·9449	36·7235	38·5926	40·5564	42·6195
11	34·0013	35·9620	38·0388	40·2379	42·5661	45·0306	47·6388	50·3985	53·3178	56·4053
12	42·1416	44·8737	47·7877	50·8950	54·2077	57·7386	61·5013	65·5100	69·7800	74·3270
13	51·9913	55·7459	59·7788	64·1097	68·7596	73·7506	79·1066	84·8529	91·0161	97·6250
14	63·9095	69·0100	74·5280	80·4961	86·9495	93·9258	101·465	109·612	118·411	127·913
15	78·3305	85·1922	92·6694	100·815	109·687	119·347	129·861	141·303	153·750	167·286
16	95·7799	104·935	114·983	126·011	138·109	151·377	165·924	181·868	199·337	218·472
17	116·894	129·020	142·430	157·253	173·636	191·735	211·723	233·791	258·145	285·014
18	142·441	158·405	176·188	195·994	218·045	242·585	269·888	300·252	334·007	371·518
19	173·354	194·254	217·712	244·033	273·556	306·658	343·758	385·323	431·870	483·973
20	210·758	237·989	268·785	303·601	342·945	387·389	437·573	494·213	558·112	630·165
21	256·018	291·347	331·606	377·465	429·681	489·110	556·717	633·593	720·964	820·215
22	310·781	356·443	408·875	469·056	538·101	617·278	708·031	811·999	931·044	1067·28
23	377·045	435·861	503·917	582·630	673·626	778·771	900·199	1040·36	1202·05	1388·46
24	457·225	532·750	620·817	723·461	843·033	982·251	1144·25	1332·66	1551·64	1806·00
25	554·242	650·955	764·605	898·092	1054·79	1238·64	1454·20	1706·80	2002·62	2348·80
26	671·633	795·165	941·465	1114·63	1319·49	1561·68	1847·84	2185·71	2584·37	3054·44
27	813·676	971·102	1159·00	1383·15	1650·36	1968·72	2347·75	2798·71	3334·84	3971·78
28	985·548	1185·74	1426·57	1716·10	2063·95	2481·59	2982·64	3583·34	4302·95	5164·31
29	1193·51	1447·61	1755·68	2128·96	2580·94	3127·80	3788·96	4587·68	5551·80	6714·60
30	1445·15	1767·08	2160·49	2640·92	3227·17	3942·03	4812·98	5873·23	7162·82	8729·99
31	1749·63	2156·84	2658·40	3275·74	4034·97	4967·95	6113·48	7518·74	9241·04	11350·0
32	2118·06	2632·34	3270·84	4062·91	5044·71	6260·62	7765·12	9624·98	11921·9	14756·0
33	2563·85	3212·46	4024·13	5039·01	6306·89	7889·38	9862·70	12321·0	15380·3	19183·8
34	3103·25	3920·20	4950·68	6249·38	7884·61	9941·62	12526·6	15771·8	19841·6	24939·9
35	3755·94	4783·64	6090·33	7750·23	9856·76	12527·4	15909·8	20189·0	25596·7	32422·9
36	4545·68	5837·05	7492·11	9611·28	12322·0	15785·6	20206·5	25842·9	33020·7	42150·7
37	5501·28	7122·20	9216·30	11919·0	15403·4	19890·8	25663·2	33079·9	42597·7	54796·9
38	6657·55	8690·08	11337·0	14780·5	19255·3	25063·4	32593·3	42343·2	54952·0	71237·0
39	8056·63	10602·9	13945·6	18328·9	24070·1	31580·9	41394·5	54200·4	70889·1	92609·1
40	9749·52	12936·5	17154·0	22728·8	30088·7	39793·0	52572·0	69377·5	91448·0	120393·0
41	11797·9	15783·6	21100·5	28184·7	37611·8	50140·2	66767·4	88804·1	117969·0	156512·0
42	14276·5	19257·0	25954·6	34950·0	47015·8	63177·6	84795·6	113670·0	152181·0	203466·0
43	17275·6	23494·5	31925·1	43339·1	58770·7	79604·8	107691·0	145499·0	196314·0	264507·0
44	20904·4	28664·3	39268·9	53741·4	73464·4	100303·0	136769·0	186240·0	253246·0	343860·0
45	25295·3	34971·4	48301·8	66640·4	91831·5	126383·0	173698·0	238388·0	326689·0	447019·0
46	30608·4	42666·1	59412·2	82635·1	114790·0	159243·0	220597·0	305137·0	421430·0	581126·0
47	37037·1	52053·7	73078·0	102468·0	143489·0	200648·0	280160·0	390577·0	543645·0	755465·0
48	44815·9	63506·5	89886·9	127062·0	179362·0	252817·0	355804·0	499939·0	701303·0	982106·0
49	54228·3	77478·9	110562·0	157558·0	224204·0	318550·0	451872·0	639923·0	904682·0	1276740·0
50	65617·2	94525·3	135992·0	195373·0	280256·0	401374·0	573878·0	819103·0	1167040·0	1659760·0

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table C $s_{n|r} = \frac{(1+r)^n - 1}{r}$ (continued)

Year	Percentage									
	31	32	33	34	35	36	37	38	39	40
1	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000
2	2·31000	2·32000	2·33000	2·34000	2·35000	2·36000	2·37000	2·38000	2·39000	2·40000
3	4·02610	4·06240	4·09890	4·13560	4·17250	4·20960	4·24690	4·28440	4·32210	4·36000
4	6·27419	6·36237	6·45154	6·54170	6·63288	6·72506	6·81825	6·91247	7·00772	7·10400
5	9·21919	9·39833	9·58054	9·76588	9·95438	10·1461	10·3410	10·5392	10·7407	10·9456
6	13·0771	13·4058	13·7421	14·0863	14·4384	14·7987	15·1672	15·5441	15·9296	16·3238
7	18·1311	18·6956	19·2770	19·8756	20·4919	21·1262	21·7790	22·4509	23·1422	23·8534
8	24·7517	25·6782	26·6384	27·6333	28·6640	29·7316	30·8373	31·9822	33·1676	34·3947
9	33·4247	34·8953	36·4291	38·0287	39·6964	41·4350	43·2471	45·1354	47·1030	49·1526
10	44·7864	47·0618	49·4507	51·9584	54·5902	57·3516	60·2485	63·2869	66·4731	69·8137
11	59·6701	63·1215	66·7695	70·6243	74·6967	78·9982	83·5404	88·3359	93·3977	98·7391
12	79·1679	84·3204	89·8034	95·6365	101·841	108·437	115·450	122·904	130·823	139·235
13	104·710	112·303	120·439	129·153	138·485	148·475	159·167	170·607	182·844	195·929
14	138·170	149·240	161·183	174·065	187·954	202·926	219·059	236·438	255·153	275·300
15	182·003	197·997	215·374	234·247	254·738	276·979	301·111	327·284	355·662	386·420
16	239·423	262·356	287·447	314·891	344·897	377·692	413·522	452·652	495·370	541·988
17	314·645	347·309	383·305	422·954	466·611	514·661	567·524	625·659	689·565	759·784
18	413·185	459·449	510·795	567·758	630·925	700·939	778·509	864·410	959·495	1064·70
19	542·272	607·472	680·358	761·796	852·748	954·277	1067·56	1193·89	1334·70	1491·58
20	711·376	802·863	905·876	1021·81	1152·21	1298·82	1463·55	1648·56	1856·23	2089·21
21	932·903	1060·78	1205·81	1370·22	1556·48	1767·39	2006·07	2276·02	2581·16	2925·89
22	1223·10	1401·23	1604·73	1837·10	2102·25	2404·65	2749·31	3141·90	3588·81	4097·24
23	1603·26	1850·62	2135·30	2462·71	2839·04	3271·33	3767·56	4336·83	4989·45	5737·14
24	2101·28	2443·82	2840·94	3301·03	3833·71	4450·00	5162·55	5985·82	6936·34	8033·00
25	2753·67	3226·84	3779·45	4424·38	5176·50	6053·00	7073·70	8261·43	9642·51	11247·2
26	3608·31	4260·43	5027·67	5929·67	6989·28	8233·09	9691·97	11401·8	13404·1	15747·1
27	4727·89	5624·77	6687·81	7946·76	9436·53	11198·0	13279·0	15735·4	18632·7	22046·9
28	6194·53	7425·70	8895·78	10649·7	12740·3	15230·3	18193·2	21715·9	25900·4	30866·7
29	8115·84	9802·92	11832·4	14271·5	17200·4	20714·2	24925·7	29969·0	36002·6	43214·3
30	10632·7	12940·9	15738·1	19124·9	23221·6	28172·3	34149·2	41358·2	50044·6	60501·1
31	13929·9	17082·9	20932·6	25628·3	31350·1	38315·3	46785·4	57075·3	69563·0	84702·5
32	18249·2	22550·5	27841·4	34342·9	42323·7	52109·8	64097·1	78764·9	96693·5	118585·0
33	23907·4	29767·6	37030·1	46020·5	57137·9	70870·3	87814·0	108697·0	134405·0	166019·0
34	31319·7	39294·3	49251·0	61668·5	77137·2	96384·6	120306·0	150002·0	186824·0	232428·0
35	41029·8	51869·4	65504·8	82636·8	104136·0	131084·0	164820·0	207004·0	259686·0	325400·0
36	53750·1	68468·6	87122·4	110734·0	140585·0	178275·0	225805·0	285667·0	360965·0	455561·0
37	70413·6	90379·6	115874·0	148385·0	189791·0	242456·0	309354·0	394221·0	501742·0	637787·0
38	92242·8	119302·0	154113·0	198837·0	256218·0	329741·0	423816·0	544026·0	697423·0	892903·0
39	120839·0	157480·0	204972·0	266442·0	345896·0	448448·0	580629·0	750757·0	969419·0	1250060·0
40	158309·0	207874·0	272613·0	357034·0	466960·0	609890·0	795462·0	1036050·0	1347490·0	1750090·0
41	207374·0	274395·0	362577·0	478426·0	630398·0	829452·0	1089780·0	1429740·0	1873020·0	2450130·0
42	271661·0	362202·0	482228·0	641092·0	851038·0	1128060·0	1493010·0	1973050·0	2603490·0	3430180·0
43	355877·0	478108·0	641364·0	859065·0	1148900·0	1534160·0	2045420·0	2722810·0	3618860·0	4802260·0
44	466200·0	631104·0	853015·0	1151150·0	1551020·0	2086450·0	2802220·0	3757470·0	5030210·0	6723160·0
45	610723·0	833058·0	1134510·0	1542540·0	2093880·0	2837580·0	3839050·0	5185310·0	6992000·0	9412420·0
46	800048·0	1099640·0	1508900·0	2067000·0	2826730·0	3859110·0	5259500·0	7155730·0	9718880·0	13177400·0
47	1048060·0	1451520·0	2004840·0	2769790·0	3816090·0	5248390·0	7205510·0	9874910·0	13509200·0	18448400·0
48	1372970·0	1916010·0	2669100·0	3711510·0	5151720·0	7137810·0	9871550·0	13627400·0	18777800·0	25827700·0
49	1798570·0	2529140·0	3549900·0	4973430·0	6954830·0	9707420·0	13524000·0	18805800·0	26101200·0	36158800·0
50	2354150·0	3338460·0	4721370·0	6664400·0	9389020·0	13202100·0	18527900·0	25952000·0	36280700·0	50622300·0

APPENDIX IV

Compounding and Discount Tables for Project Evaluation

Table C $s_{n|r} = \frac{(1+r)^n - 1}{r}$ (continued)

Year	Percentage 41	42	43	44	45	46	47	48	49	50
1	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000	1·00000
2	2·41000	2·42000	2·43000	2·44000	2·45000	2·46000	2·47000	2·48000	2·49000	2·50000
3	4·39810	4·43640	4·47490	4·51360	4·55250	4·59160	4·63090	4·67040	4·71010	4·75000
4	7·20132	7·29969	7·39911	7·49958	7·60113	7·70374	7·80742	7·91219	8·01805	8·12500
5	11·1539	11·3656	11·5807	11·7994	12·0216	12·2475	12·4769	12·7100	12·9469	13·1875
6	16·7269	17·1391	17·5604	17·9911	18·4314	18·8813	19·3411	19·8109	20·2909	20·7812
7	24·5850	25·3375	26·1114	26·9072	27·7255	28·5667	29·4314	30·3201	31·2334	32·1719
8	35·6648	36·9793	38·3393	39·7464	41·2019	42·7073	44·2641	45·8737	47·5378	49·2578
9	51·2874	53·5106	55·8252	58·2348	60·7428	63·3527	66·0682	68·8931	71·8313	74·8867
10	73·3153	76·9850	80·8301	84·8582	89·0771	93·4950	98·1203	102·962	108·029	113·330
11	104·375	110·319	116·587	123·196	130·162	137·503	145·237	153·383	161·963	170·995
12	148·168	157·653	167·719	178·402	189·735	201·754	214·498	228·008	242·324	257·493
13	209·917	224·867	240·839	257·899	276·115	295·561	316·312	338·451	362·063	387·239
14	296·983	320·311	345·400	372·374	401·367	432·519	465·979	501·908	540·474	581·859
15	419·746	455·841	494·921	537·219	582·982	632·477	685·989	743·823	806·306	873·788
16	592·842	648·294	708·738	774·595	846·324	924·417	1009·40	1101·86	1202·40	1311·68
17	836·907	921·578	1014·49	1116·42	1228·17	1350·65	1484·82	1631·75	1792·57	1968·52
18	1181·04	1309·64	1451·73	1608·64	1781·85	1972·95	2183·69	2415·99	2671·93	2953·78
19	1666·26	1860·69	2076·97	2317·44	2584·68	2881·50	3211·03	3576·67	3982·18	4431·68
20	2350·43	2643·18	2971·07	3338·12	3748·78	4207·99	4721·21	5294·47	5934·44	6648·51
21	3315·11	3754·31	4249·63	4807·89	5436·73	6144·67	6941·18	7836·81	8843·32	9973·77
22	4675·31	5332·13	6077·97	6924·36	7884·26	8972·22	10204·5	11599·5	13177·5	14961·7
23	6593·18	7572·62	8692·49	9972·08	11433·2	13100·4	15001·7	17168·2	19635·5	22443·5
24	9297·39	10754·1	12431·3	14360·8	16579·1	19127·6	22053·4	25410·0	29258·0	33666·2
25	13110·3	15271·8	17777·7	20680·5	24040·7	27927·4	32419·6	37607·8	43595·4	50500·3
26	18486·5	21687·0	25423·1	29781·0	34860·0	40774·9	47657·7	55660·5	64958·1	75751·5
27	26067·0	30796·6	36356·1	42885·6	50548·1	59532·4	70057·9	82378·5	96788·6	113628·0
28	36755·5	43732·1	51990·2	61756·3	73295·7	86918·3	102986·0	121921·0	144216·0	170443·0
29	51826·3	62100·6	74346·9	88930·0	106280·0	126902·0	151391·0	180444·0	214883·0	255666·0
30	73076·0	88183·9	106317·0	128060·0	154107·0	185278·0	222545·0	267059·0	320176·0	383500·0
31	103038·0	125222·0	152034·0	184408·0	223456·0	270506·0	327142·0	395248·0	477064·0	575251·0
32	145285·0	177816·0	217410·0	265548·0	324012·0	394940·0	480900·0	584968·0	710826·0	862878·0
33	204853·0	252500·0	310898·0	382390·0	469818·0	576613·0	706924·0	865754·0	1059130·0	1294320·0
34	288843·0	358551·0	444585·0	550643·0	681237·0	841857·0	1039180·0	1281320·0	1578110·0	1941480·0
35	407270·0	509144·0	635757·0	792927·0	987794·0	1229110·0	1527600·0	1896350·0	2351380·0	2912220·0
36	574252·0	722986·0	909134·0	1141820·0	1432300·0	1794500·0	2245570·0	2806600·0	3503560·0	4368330·0
37	809696·0	1026640·0	1300060·0	1644220·0	2076840·0	2619980·0	3300980·0	4153770·0	5220300·0	6552490·0
38	1141670·0	1457830·0	1859090·0	2367670·0	3011420·0	3825170·0	4852450·0	6147570·0	7778250·0	9828740·0
39	1609760·0	2070120·0	2658500·0	3409450·0	4366560·0	5584750·0	7133100·0	9098410·0	11589600·0	14743100·0
40	2269760·0	2939570·0	3801660·0	4909610·0	6331510·0	8153730·0	10485700·0	13465700·0	17268500·0	22114700·0
41	3200360·0	4174190·0	5436370·0	7069840·0	9180690·0	11904400·0	15413900·0	19929200·0	25730100·0	33172000·0
42	4512510·0	5927360·0	7774010·0	10180600·0	13312000·0	17380500·0	22658400·0	29495200·0	38337800·0	49758000·0
43	6362650·0	8416850·0	11116800·0	14660000·0	19302400·0	25375500·0	33307900·0	43652800·0	57123300·0	74637000·0
44	8971330·0	11951900·0	15897100·0	21110400·0	27988500·0	37048300·0	48962600·0	64606200·0	85113700·0	111955000·0
45	12649600·0	16971700·0	22732800·0	30399000·0	40583300·0	54090500·0	71975100·0	95617200·0	126819000·0	167933000·0
46	17835900·0	24099900·0	32507900·0	43774600·0	58845800·0	78972100·0	105803000·0	141513000·0	188961000·0	251900000·0
47	25148600·0	34221800·0	46486300·0	63035400·0	85326400·0	115299000·0	155531000·0	209440000·0	281552000·0	377850000·0
48	35459600·0	48595000·0	66475500·0	90771000·0	123723000·0	168337000·0	228631000·0	309971000·0	419512000·0	566775000·0
49	49998000·0	69004800·0	95059900·0	130710000·0	179399000·0	245772000·0	336087000·0	458757000·0	625073000·0	850162000·0
50	70497200·0	97986900·0	135936000·0	188223000·0	260128000·0	358827000·0	494048000·0	678961000·0	931359000·0	1275240000·0

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